Miss Florence Hedges,
Laboratory of Plant Pathology,
U. S. Department of Agriculture,
Washington, D. C.

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

Supplement 27

Diseases of Cereal and Forage Crops

In the United States in 1922

July 1, 1923

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

DISEASES OF CEREAL AND FORAGE CROPS

IN THE UNITED STATES IN 1922.

Prepared by R. J. Haskell, Plant Pathologist, and
Jessie I. Wood, Junior Pathologist,
Plant Disease Survey.

CONTENTS

INTRODUCTORY STATEMENT

This summary of the diseases of cereal and forage crops in 1922 is based on information obtained from various sources, chief among which are the collaborators of the Plant Disease Survey, the Office of Cereal Investigations, and the Plant Disease Survey of the Dominion of Canada (Survey of the prevalence of plant diseases in the Dominion of Canada (mimeographed). Ann. Rept. 3: 1-192, 1923). Reports from the Canadian provinces that are listed in the following pages have been taken directly from the publication just mentioned.

1922 weather conditions in relation to cereal diseases.

The weather for the months of March, April, June, and July probably influenced cereal diseases more than that of other months in 1922. March and April were unusually warm and wet over the greater portion of the eastern half of the country. May was warm and rather drier than usual throughout most of the winter wheat area. June was warmer than normal throughout the entire country, and it was exceptionally wet in the Atlantic Coast and Great Lakes states, but abnormally dry in the winter wheat area from Ohio westward. Dry weather prevailed also in the spring wheat section. The weather for this month greatly influenced such diseases as scab and the leaf diseases of cereals. July was the only warm-season month of the year with temperatures below normal in most sections of the country, although August was unseasonably cool in the middle and south Atlantic areas. The rainfall for July showed considerable irregularity in its distribution over individual states and regions. More precipitation than usual occurred throughout the greater portion of the Atlantic Coast states, but in New York, Western Pennsylvania, Ohio and parts of West Virginia, Kentucky, Indiana, Illinois and Missouri, Oklahoma and Texas there was a deficiency. During the month the spring wheat area experienced dry weather which cut down the amount of stem rust to a very great extent. The Pacific Northwest and the Southwest also had a deficiency of rainfall during July. (For more detailed discussion of weather for the year, see Pl. Dis. Bul. Suppl. 26, 1923).

Relative prevalence of cereal diseases in 1922

Influenced by weather conditions, the diseases of cereal and forage crops varied greatly in their relative prevalence. The two outstanding epidemic diseases were the powdery mildew of red clover and the leaf rusts of small grains. In addition to these the following diseases were unusually severe: bunt of wheat in the Northwest, scab of the small cereals in the Atlantic Coast States, nematode of wheat in Virginia, anthracnose of wheat and rye in Ohio, Helminthosporium leaf blight of corn in Connecticut and adjacent states, Diplodia seedling blight in parts of the corn belt, flax rust in Minnesota, alfalfa rust and the leaf spot of alfalfa in New York and New England.

Of the diseases that were not so severe as usual may be mentioned: the stem rust of cereals, stripe rust of wheat, barley and grasses, scab of the small grains in the western part of the soft red winter wheat and the spring wheat areas, take-all of wheat in New York, ergot in the durum wheat area, the smuts of oats, corn smut and flax wilt.

The majority of the remaining diseases of cereals apparently occurred to about the usual extent without marked variations in severity.

New diseases, new hosts and new occurrences.

A considerable number of new diseases were described in literature or reported to the Survey during the year. Other diseases were found in new localities for the first time and several organisms were described or reported on new hosts. These diseases have been classified and appear below in the following lists:

New diseases

Wheat

Leptosphaeria sp. - New York
Mosaic - Nebraska

Oats

Leptosphaeria avenaria Weber (Septoria avenae Frank) - Wisconsin

Corn

Bacterium dissolvens Rosen (the cause of bacterial stalk rot, previously reported from Arkansas but organism not named)

Flax

Two new diseases, causes not definitely determined.

Cowpea

Alternaria atrans Gibson (secondary), - Arizona.
Bacterium vignae Gardner & Kendrick, Indiana (observed since 1919)

Soybean

Alternaria atrans Gibson - Arizona.
Peronospora sp. - New York.
Phomopsis sojae Lehman - North Carolina.

Grasses

Pythium sp. on *Agrostis palustris* - Connecticut.

Diseases found in new localities

Wheat

Tylenchus tritici (Stein.) Bast. - Haywood County, North Carolina
Urocystis tritici Koke. - Missouri
Sclerotium rhizoides Auersw. - Idaho

Barley

Puccinia simplex (Koern.) Erikss. & Henn. - Manitoba
Rhynchosporium secalis (Heins) Davis - Canada (Alberta)

Alfalfa

Uromyces striatus Schroet. (Uromyces medicaginis Pass.) - Pennsylvania, nia, Illinois

Cowpea

Cercospora cruenta Sacc. - Illinois.

Soybean

Mosaic - Connecticut, New York, Virginia, Kentucky, Louisiana.

Grasses

Uromyces dactylidis Otth on *Dactylis glomerata* - Virginia.

Organisms found on new hosts.

Rye

Tilletia tritici (Bjerk.) Wint. - Washington (artificial inoculation 1922, natural infection 1921)

Soybean

Bacterium solanacearum EFS - North Carolina (found in 1921)

Grasses

Ophiobolus cariceti (Berk. & Br.) Sacc. on *Phleum pratense*, *Agrostis palustris*, and *Poa compressa*, - all from New York
Puccinia glumarum (Schm.) Erikss. & Henn. (see under miscellaneous grasses).
Septoria bromi Sacc. on *Bromus inermis*, - Wisconsin (miscellaneous grasses(7)).
Urocystis agropyri (Preuss) Schröt.) on *Agrostis palustris* - Wisconsin

Diseases that should be kept under observation

Certain diseases of cereals and forage crops should be carefully watched during the coming seasons on account of the possibility of their becoming more widespread and destructive. They are potentially dangerous.

1. Flag smut of wheat (*Urocystis tritici* Koke.) This is a disease of comparatively recent introduction and, although occurring only in a small area in the vicinity of St. Louis, it has possibilities of becoming a very serious disease, if it becomes widespread.

2. The Sclerotium disease of wheat (Sclerotium rhizoides Auersw.) was reported for the first time this year in Idaho. The only previous collection that we have a record of came from Montana. The disease should be watched for in these and in other states and observations made concerning it.

3. The head smut of corn (Sorosporium reilianum (Kühn) McAlp.) in the state of Washington and previously it has been collected in California. This disease may possibly be a menace to the corn crop.

4. The mosaic disease of corn which during 1922 was reported from Arkansas, and which in other years has been recorded in some of our other southern states, may be very dangerous potentially. If it is the same mosaic as that described from Hawaii, it certainly would be a calamity if it should become widespread and attack corn in the United States with the same severity that it does in Hawaii.

5. The bacterial stalk rot of corn (Bacterium dissolvens Rosen) reported in this bulletin from Arkansas and Illinois should be watched and studied.

6. The clover nematode (Tylenchus dipsaci (Kühn) Bastian) that occurs in some of the northwestern states needs continued observation in the states where it occurs and in adjoining territory. Since much of the clover seed that is planted in the East comes from the western seed producing areas, the disease should be watched for in the East also.

7. The powdery mildew of clover which, during the past two years, has been epidemic, deserves further study and observation to explain its unusually wide prevalence.

Mosaic diseases

Mosaic diseases were reported on the following hosts during 1922: wheat in Nebraska, sweet clover in Minnesota, cowpea in Arkansas and Indiana, soy bean in Connecticut, New York, Virginia, Kentucky, Louisiana, and Indiana, and corn in Arkansas.

DISEASES OF CEREAL CROPS

WHEAT

Bunt caused by Tilletia laevis Kühn and T. tritici (Bjerk.) Wint.

In the summaries of the wheat bunt situation for other years it has been brought out that of the two smut fungi causing bunt, Tilletia laevis and T. tritici, the former T. laevis, is by far the more widespread in the United States, it being the form that occurs commonly throughout all of the eastern states. T. tritici on the other hand is not important or common east of the Rocky Mountains, but it is the important form west of the mountains in the northwestern wheat region, and it is in this area that the heaviest losses from bunt occur. Regarding the geographic distribution of bunt in western United States, Stephens and Woolman (7) report as follows:

> "West of the Rockies Tilletia tritici is by far the more prevalent. According to Prof. W. W. Mackie, of the University of California, it is practically the only species found in California. The two (smuts) occur in Western Oregon, and in the Willamette Valley in particular, where they are about equally abundant. In the wheat belt of Eastern Oregon and Washington and Northern Idaho, or what is generally called the Inland Empire, T. laevis has not been found in the field. It does, however, occur in Southern Idaho, notably around Pocatello, where in 1918 it was found by the junior writer in wheat stored in warehouses."

The question as to why Tilletia tritici is the important smut in the West, and T. laevis is the prevalent one in the East, is an interesting one and a subject for further study. Possibly some light may be thrown on this point by the observations of R. S. Kirby of New York, 1922, who reported that T. tritici was brought into New York from the state of Washington in Number Four wheat, but that the percentage of this smut is rapidly becoming smaller each year without any seed treatment.

In 1922 bunt was reported from the majority of the states in the country. Most of these reported it as being prevalent in about the same, or perhaps slightly less amounts than, last year. Maryland and Virginia, however, estimated more, as also did all of the northwestern states.

Of the eastern states only four reported more than a trace of bunt. Elliott estimated 2% loss in Arkansas and makes the statement that many farmers do not treat their seed until they experience very heavy losses. In Illinois, where this year a systematic examination of wheat fields was made by the Natural History Survey, a large area in the northern part of the state was found where bunt was abundant. As a result of their survey, it was estimated that the disease occurred in about 40% of the fields in the state and that the reduction in yield was probably not far from 2%. The presence of bunt in wheat caused a considerable dockage at elevators and mills in Illinois. Maryland, Virginia and Tennessee estimated 1% loss from bunt in 1922.

Table 63. Estimated loss of wheat from bunt, according to collaborators, 1922.

Approximate percentage loss.	States
8	Idaho
5	Washington
2	Arkansas and Illinois
1	Maryland, Virginia and Tennessee
1/2	California
Trace	Massachusetts, New York, Pennsylvania, Delaware, West Virginia, Ohio, Indiana, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Kansas, Colorado.

Table 64. Highest percentages of bunt in individual fields, according to collaborators, 1922.

Highest percentage	States
50	Michigan, Kansas, South Dakota, Colorado, Idaho.
35	Washington
15	Ohio
12	Iowa
10	Georgia, Illinois, Minnesota, North Dakota.
8	Pennsylvania
6	New York

As will be seen from the following reports, bunt was reported as being much more prevalent in the Northwest this year than last.

Montana: More stinking smut this year in fields where seed grain was not treated. (Jennison).

Idaho: Much worse in northern Idaho than last year, many fields having from 20 to 45%. Very important on all dry land wheat. (Hungerford).

Washington: More than average amount of smut in the Palouse country. One hundred eighteen counts of 1,000 heads each were made on 61 farms scattered over eastern Washington. They showed an average of 8.4% smut in the crop. This may be taken as a fair average of the entire acreage. Counts ranged from 0 to 35% smut. A number of smut explosions occurred in thrashing machines. (Dana).

Oregon: Appears to be worse than last year, loss of half a million dollars is estimated for Umatilla County,- the largest in wheat production in the state. (Barss).

California: Continued reduction of bunt is apparent in this year's crop. The effects of the smut campaign are evidently apparent in the reduction of bunt. It is estimated that the attack will average less than one half of 1%, with many areas averaging less than one tenth of 1%. Many thousands of acres smut-free. (Mackie).

Factors influencing the amount of bunt

The question arises as to the reason for the increase in the amount of bunt in Montana, Idaho, Washington, and Oregon. In a recent paper, Hungerford (5) has shown that low soil temperatures and a fairly high percentage of moisture in the soil at seeding time, are conducive to bunt infection. In a series of controlled greenhouse experiments, he found that the highest percentage of infection was secured at temperatures ranging from 9 to 12°C. (48 to 54°F), and in soil containing 22% moisture and with a moisture equivalent to 20.7. At the highest temperatures there was a falling off in the amount of disease, and in soils where there was an extremely high percentage of moisture, infection seemed to be inhibited.

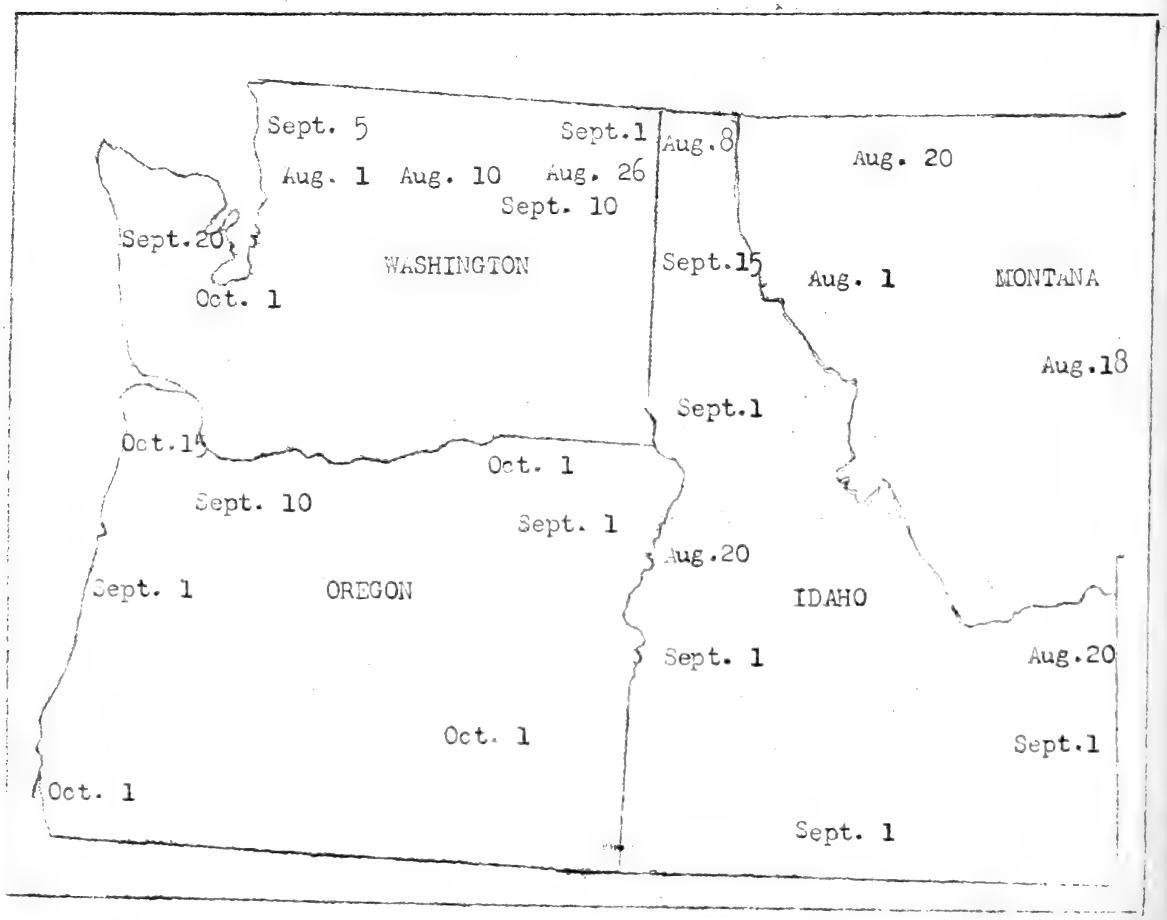


Fig. 15. Dates when seeding of winter wheat begins (Seedtime and harvest. U. S. D. A. Circ. 183. 1922).

In another recent report by C. O. Johnston (6), the statement is made that in Kansas "Later dates of planting show consistently higher percentages of bunt than the earlier plantings, the amount of smut gradually increasing in consecutive plantings from September 15 to November 1, after which the percentage of infection rapidly declines." This statement tends to bear out that of Hungerford that cooler temperatures, up to a certain limit, favor infection.

In the four northwestern states just mentioned, seeding of winter wheat takes place, for the most part, during September, as is shown by the accompanying map (Fig. 15). In looking up the temperatures for September 1921, it was found that during the month there was a great deficiency, a large proportion of the area having temperatures 3° below normal for the month (See Fig. 16). For Washington the statement is made (Climatological data for the United States by Sections: 8 Sept. 1921) that the month was unusually cool for September, the monthly mean being 55.1°. In 32 years the only September that appears to be cooler for the state as a whole was that of 1895. For Idaho it is recorded that the temperature for September 1921 was second lowest for the month since state-wide records began in 1893. The monthly mean for the state was 53°. In Oregon the temperatures east of the Cascade Mountains ranged from 2 to nearly 10° below normal with a monthly mean for the entire state of 56.2°.

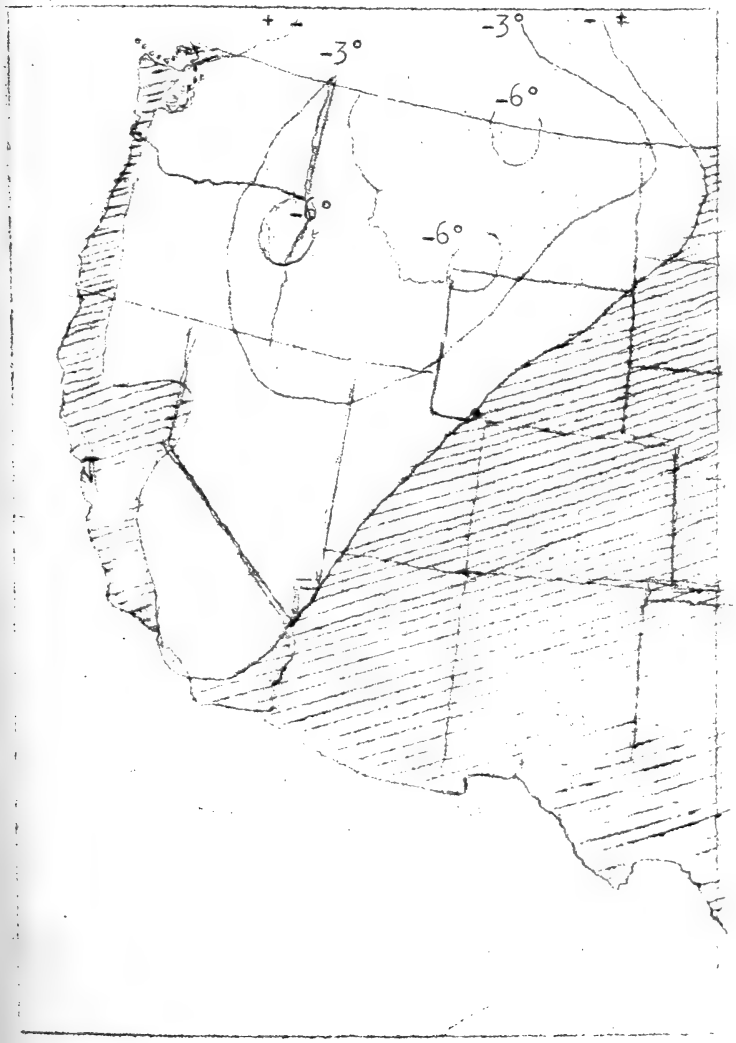


Fig. 16. Departure from normal temperature September 1921. Shaded area represents excess, nonshaded area, deficiency. (Climatological Data 8 (9). September 1921).

An examination of the precipitation records for the same month does not show anything very unusual. Rainfall varied widely in different parts of the states. If anything, conditions were somewhat drier than usual in the eastern parts of Washington and Oregon and in Idaho. However, there was apparently plenty of moisture to favor infection with bunt. While the compilers of this summary

do not claim that there is necessarily any distinct correlation of bunt infection in the Northwest and the cool temperatures of September 1921, nevertheless, the facts are at least somewhat significant and suggestive.

Varietal susceptibility

During 1922 the work of testing varieties for their susceptibility and resistance to bunt was continued in a number of places. The most important work along this line that has appeared is that of Stephens and Woolman (7), who report the results of their experiments since 1917. The project they report is a co-operative one between the Oregon Agricultural Experiment Station and the Office of Cereal Investigations of the Department of Agriculture. All of the commercial wheat varieties of the United States, Australia, and India, as well as entries of pure-line selections of wheat varieties were tested for smut at Moro for the two years 1919 and 1920. As a result of this work a few pure-line selections were discovered that seem to be totally immune to both species of stinking smut, and nearly 20 varieties were found that were so highly resistant to bunt that they can safely be sown without seed treatment. Of these varieties, those appearing most promising are as follows:

Turkey C. I. 1558 A	Turkey C. I. 1571 C	White Odessa C. I. 4655
Turkey C. I. 1558 B	Crimean C. I.2903-5	Martin C. I. 4463
Turkey C. I. 3055	Crimean C. I.4430	Hussar C. I. 4843
		Turkey x Florence(Several hybrids)

These wheats have been tested for yields and some of them have been found to be very satisfactory for Oregon. The discovery of them is likely to prove of much economic importance.

In Kansas, C. O. Johnston (6) has reported that Kanred, while apparently resistant to Tilletia tritici, is no more resistant to T. laevis than Turkey, Kharkof, or other hard winter wheats. The soft red winter wheats as a group seem to be somewhat more susceptible to T. laevis than do the hard winter varieties.

From South Africa, J. E. Donkin (3) reports that of 20 varieties of wheat tested for resistance to bunt (T. tritici), the durum, polonicum and turgidum types showed evident resistance.

Bunt control

During the past year the copper carbonate dust treatment for bunt of wheat has been tested at a number of places, and in the majority of cases considerable success has been reported in its use. The following reports are from individual investigators.

Michigan (2): Copper carbonate, copper sulphate and lime dusts, using heavily smutted winter wheat, have given the following results in comparison with the standard formaldehyde treatments in stinking smut control:

WHEAT - Bunt

Treatment	Percent of smut	Stand Per cent
Control	46	100
Dry formaldehyde	3	98
Wet formaldehyde	0	97
Soak and skim formaldehyde method	0.5	97
Copper sulphate and lime dust, 2 oz. per bu.	3.7	97
Untreated	44	100
Copper carbonate, 4 oz. per bu.	2.6	98
Untreated	15.7	100
Copper carbonate, 2 oz. per bu.	1.4	97
" " 4 " " "	2.4	95
" " 8 " " "	0.9	90
" " 16 " " "	0	90
Untreated	33.3	100
Copper sulphate and lime dust 2 oz. per bu.	4.6	98
" " " " " 4 " " "	4	97
" " " " " 8 " " "	2.6	93
" " " " " 16 " " "	4.2	90
Control	44	100
Copper sulphate dehydrated, 2 oz. per bu.	3.1	85
" " " 4 " " "	4.3	80
" " " 8 " " "	0.5	80
" " " 16 " " "	2.1	80
Sulphur, superfine, 2 oz. per bu.	14.	100

Considering the heavy smut production in the controls and the marked reduction brought about by both copper carbonate and copper sulphate and lime dusts, it is believed that use of these with fairly clean grain would give satisfactory stinking smut control. Tests with oats were not satisfactory in smut control. (G. H. Coons).

North Dakota: Copper carbonate tried in many localities, but smutted wheat seed was not available for check. Smutted Marquis at Fargo developed very few smutted heads. (Wanda Woniger)

South Dakota: Excellent results with copper carbonate. (Evans)

Idaho: Tests have been made during the last two years with several dust treatments for the control of stinking smut. None of these treatments have given as good control of this disease as the standard bluestone treatment, 1 pound bluestone to 5 gallons of water, under the conditions where they have been tried.

Preliminary tests carried on in 1921 seemed to indicate that copper carbonate was not effective when applied to badly smutted seed but might be effective with seed not heavily smutted. In order to test this question as well as to compare the efficiency of copper carbonate dust and bluestone under the same conditions an experiment was conducted, the results of which are given in the following table. It will be noted that in no case was complete control secured. This was doubtless due to especially heavy soil infection which prevailed this year.

Table 65. Seed treatment tests in Idaho, 1922.

Amount of smut by weight (inoculum)	Percentage of bunt (average of 3 counts) Copper carbonate: 2 oz. to bushel	Copper sulphate: (bluestone) 1 lb. - 5 gal.	Control, not treated
1 - 10,000	16	5 1/2	25
1 - 5,000	22	12	25
1 - 1,000	23	10	55
1 - 500	17	11 1/2	52
Stand	58	35	50

(C. W. Hungerford).

Washington: The following table of comparison is given by Heald and Smith (4)

Table 66. Comparison of dust and wet seed treatments, Washington, 1921.

Treatment	Bluestem: Per cent germination	Bluestem: Per cent smutted plants	Bluestem: Per cent smutted heads	Jenkins Club: Per cent germination	Jenkins Club: Per cent smutted plants	Jenkins Club: Per cent smutted heads
Check, untreated	84.25	15.06	13.6	89.5	4.5	3.2
Bluestone, wet	67	0	0	65.5	1.2	0.4
Formaldehyde, wet	38.5	0	0	53.5	1.1	0.7
Chlorophol, wet	94.5	0	0	96	0	0
Copper carbonate 2 oz. Dust	91.5	0	0	92	0	0
Copper carbonate 4 oz. Dust	98.5	0	0	96.5	0	0
Copper sulphate - calcium carbonate (equal parts) 2 oz. Dust	92.5	0	0	94.5	0	0
Sulphur, 10 lbs. Dust	89	0.5	0.2	92	0	0
Sulphur, 20 lbs. Dust	94	0	0	93.5	0	0

Oregon(1): In the fall of 1921 statewide tests were started in Oregon by various county agents under the direction of the Experiment Station pathologist. Records of about a hundred such tests have been turned in, and the results are so satisfactory in general that the Experiment Station is encouraging more extensive testing of this method this fall. The results in other Coast states are likewise encouraging. Universal adoption of this method will not be advocated until the results of further tests fully confirm the apparent advantages of the dust treatment. (H. P. Barss)

Literature (Cited)

(1) Barss, H. P. Copper carbonate for wheat smut control. Ore. Agr. Exp. Sta. Circ. 30: 1922.

(2) Coons, G. H. Control of stinking smut of wheat (Tilletia laevis) with dust treatments (abstract). Phytopath. 13: Jan. 1923.

(3) Donkin, J. E. Bunt-resistant wheat. Jour. Dept. Agric. Union South Africa 4: 561-563. 1922.
(4) Heald, F. D. and L. J. Smith. The dusting of wheat for bunt or stinking smut. Wash. Agr. Exp. Sta. Bul. 171. 1-28. 1922. (Jan. 1923)
(5) Hungerford, Charles W. The relation of soil moisture and soil temperature to bunt infection in wheat. Phytopath. 12: 337-352. 1922.
(6) Johnston, C. O. Wheat smut investigations in Kansas: Report of progress. 1920-21. (Abstract) Phytopath. 13: 36. Jan. 1923.
(7) Stephens, D. E. and H. M. Woolman. The wheat bunt problem in Oregon. Oreg. Agr. Exp. Sta. Bul. 188: 42 p. 1922.

Not cited:

Atwood, W. M. Physiological studies of effects of formaldehyde on wheat. Bot. Gaz. 74: 233-263. Nov. 1922.
Burk. Versuche mit verschiedenen beizmitteln zur bekämpfung des steinbrandes bei weizen. Mitt. Deut. Landw. Ges. 37: 11-14. 1922.
Coons, G. H. Copper-dust treatment for stinking smut. Quart. Bul. Mich. Agr. Exp. Sta. 5: 8-11. 1922.
Heald, F. D. and L. J. Smith. The dusting of wheat for bunt or stinking smut. Wash. Agr. Exp. Sta. Bul. 168: 1-15. 1922.
Heuser, W. Versuche über einfluss äusserer bedingungen auf die stärke des steinbrandbefalles des weizens. Ill. Landw. Zeit. 71: 81-99. 1922.
Salmon, E. S. A safe method of preventing "bunt" in wheat. Jour. Min. Agr. Great Britain 29: 722-728. Nov. 1922.
Woolman, H. M. Cytological studies on the infection of wheat seedlings by Tilletia tritici (Bjerk.) Wint. (Abstract) Phytopath. 13: 36-37. Jan. 1923.
Zade, Adolf. Die bekämpfung des weisensteinbrandes mittels des formalinauslaugungsverfahrens. Illustr. Landw. Zeit. 42: 51-52. 1922.
Zundel, G. L. The effects of treatment for bunt on the germination of wheat. Phytopath. 11: 469-484. 1921. (Mar. 1922)

Loose smut caused by Ustilago tritici (Pers.) Jens.

During 1922 loose smut occurred widely over the United States as usual and according to collaborators' reports it was about normal in severity. In Washington, Oregon, and California only a very slight amount of the disease was reported. In southern Idaho, however, this smut is reported by Hungerford as being on the increase, probably causing a loss of about 1 1/2% during 1922.

By far the greatest losses occurred in the soft red winter wheat belt and in the same states where the heaviest losses from leaf rust were experienced. Collaborators in Virginia, South Carolina, Indiana, Kentucky, Arkansas and Idaho list loose smut as the second most important wheat disease in 1922, and those in Delaware, Maryland, and West Virginia list leaf rust as a most important disease with loose smut and scab as second in importance. The accompanying map (Fig. 17) shows the estimated percentages of loss from loose smut in 1922 and table 67 shows the highest percentage if loose smut in any one field.

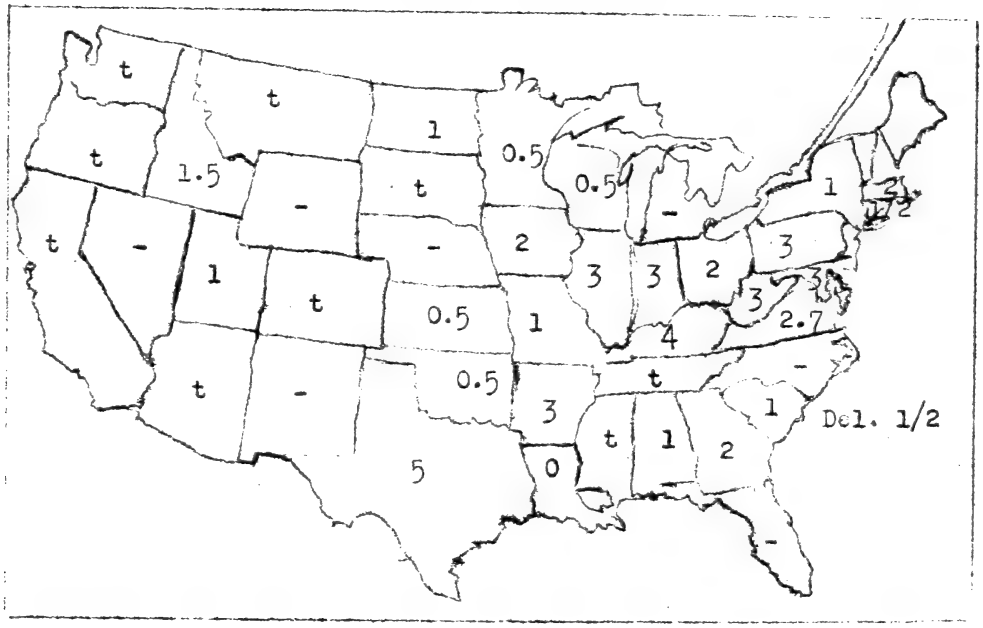


Fig. 17. Estimated percentage of loss from loose smut of wheat in 1922.

Table 67. Highest percentages of loss from loose smut of wheat in any one field as reported by collaborators, 1922.

Highest percentage of loss	States
20	Georgia
18	Ohio
10	Virginia, Illinois, Missouri
8	New York, West Virginia
5	North Dakota
3.5	Oklahoma, Arkansas
2	Delaware, Wisconsin, South Dakota

A number of factors have been reported as influencing the occurrence and severity of loose smut. Thus Coons (Phytopath. 8: 70. 1918 and Pl. Dis. Bul. Suppl. 15: 121. 1921) has reported that winter killing of wheat results in a reduction of loose smut on account of the greater susceptibility of infected plants to freezing injury. Fromme (Phytopath. 10: 53. 1920) has observed that percentages of loose smut are higher in soils of low fertility. Again collaborators in the states on the Pacific Coast have called attention several times to the fact that loose smut is of minor importance in that region, giving as a reason the dry weather conditions that prevail at flowering time. Recent studies with wheat varieties are showing that there is a wide difference in the susceptibility of various wheats to loose smut. It has been pointed out (Pl. Dis. Bul.

Suppl. 21: 152. 1922) that in 1921 the heaviest losses from loose smut occurred in the soft red winter wheat area. An examination of the accompanying map (Fig. 17.) and a comparison of it with a map showing the production of soft red winter wheat shows that the same correlation holds for 1922. It will be noted also that Hungerford, in Idaho, reported a loss of 1.5%. He observed that the disease was becoming increasingly severe in the southern part of the state on Dicklow, a common white wheat which is especially susceptible to loose smut. Fig. 18 shows that practically all of the Dicklow wheat grown in the United States is produced in southern Idaho, which accounts for the high loss there as compared with neighboring states.

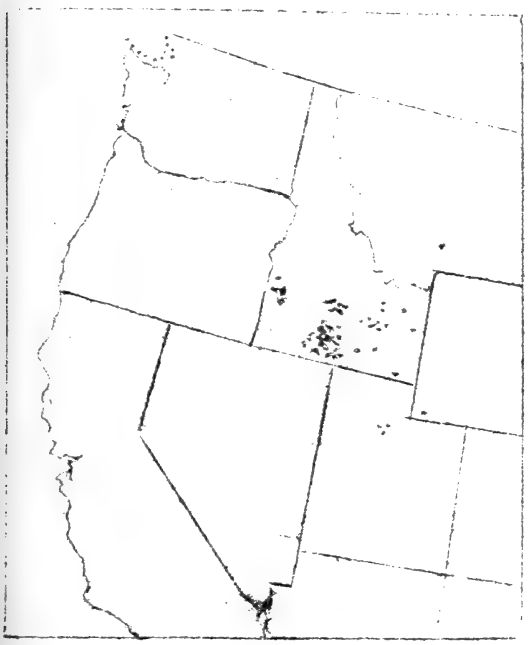


Fig. 18. Distribution of Dicklow wheat in the Pacific Northwest. Each dot represents 1,000 acres or fraction thereof per county. (Map taken from U. S. Dept. Agr. Bul. 1301, Dec. 1922.)

The subject of resistance to loose smut has been given considerable attention in Survey summaries for other years (Pl. Dis. Bul. Suppls. 15 and 21). In Supplement 15 there were summarized the results obtained in the cereal survey of 1919. Below in Table 68. are listed the susceptible and resistant varieties as reported by collaborators to the Plant Disease Survey. This is a summary of all data submitted by collaborators up to and including 1922.

In a recent article Fromme (1) presents experimental evidence showing differences in the susceptibility of varieties to loose smut infection. He finds a greater amount of loose smut in bearded than in beardless varieties in Virginia and gives further data showing the susceptibility of Stoner and the resistance of Leap (Leap's Prolific). In his collaborator's report Fromme has made the statement that the resistance in Leap is probably due to inherent immunity rather than disease escape.

Very little information concerning treatment by the hot water method was sent in by collaborators during the year. It is known that considerable work is being done in the states where the disease is most important, but in the majority of the other states the disease is so unimportant that no attention to the control of loose smut seems necessary. Tapke (2) has recently presented evidence to show that the reductions in yield from seed treated by the modified hot water method are due to the fact that injury takes place through the broken seed coats. Carefully hand-threshed seed, when treated with the hot water method, showed little or no injury.

Literature (Cited)

(1) Fromme, F. D. Incidence of loose smut in wheat varieties. Phytopath. 11: 507-510. December 1921.

(2) Tapke, V. F. Modified and simplified hot water and vapor treatments for control of loose smut in wheat, with special reference to seed injury. (Abstract) Phytopath. 13: 38. 1923.

Table 68. Varieties of wheat listed by collaborators as susceptible or resistant to loose smut. Summary of all collaborators' reports in Survey files.

SUSCEPTIBLE

Year	State	Variety	Year	State	Variety
1908	New York	Dawson's Golden Chaff	1920	Idaho	Dicklow (very)
1918	Maryland	Fulcaster, Dietz, Stoner, Mammoth Red, Bearded Purple Straw		Virginia	Stoner, Fulcaster
	Michigan	Goens	1921	Michigan	Red Rock
	New Mexico	Turkey Red		New York	Dawson's Golden Chaff, Red Rock
1919	Alabama	Mediterranean Blue Stem, Fulcaster		Ohio	Goens, Red Wave, Portage, Gladden
	Colorado	Turkey Red, Marquis		Penna.	Red Rock, Pennsylvania 44
	Georgia	Blue Stem, May		Virginia	Stoner, red Wonder, Fulcaster
	Idaho	Dicklow			
	Indiana	Red Wave, Poole	1922	Virginia	Stoner, Fulcaster
	Minnesota	Velvet Chaff, Marquis, Durum, Blue Stem		North Dak.	Preston, Durums
				Idaho	Dicklow
	Texas	Mediterranean Blue Stem, Turkey Red			
	Virginia	bearded winter, Stoner			

RESISTANT

Year	State	Variety	Year	State	Variety
1908	New York	Jones' #5	1921	New York	No. 6 Junior
				Ohio	Trumbull
				Oklahoma	Kanred, Black Hull Turkey
1919	Idaho	Forty Fold		Virginia	Leap's Prolific, Fultz
1920	Virginia	Leap's Prolific	1922	Virginia	Leap's Prolific
1921	Minnesota	Wisconsin Wonder			
				New York	No. 6 Junior

WHEAT - Flag smut

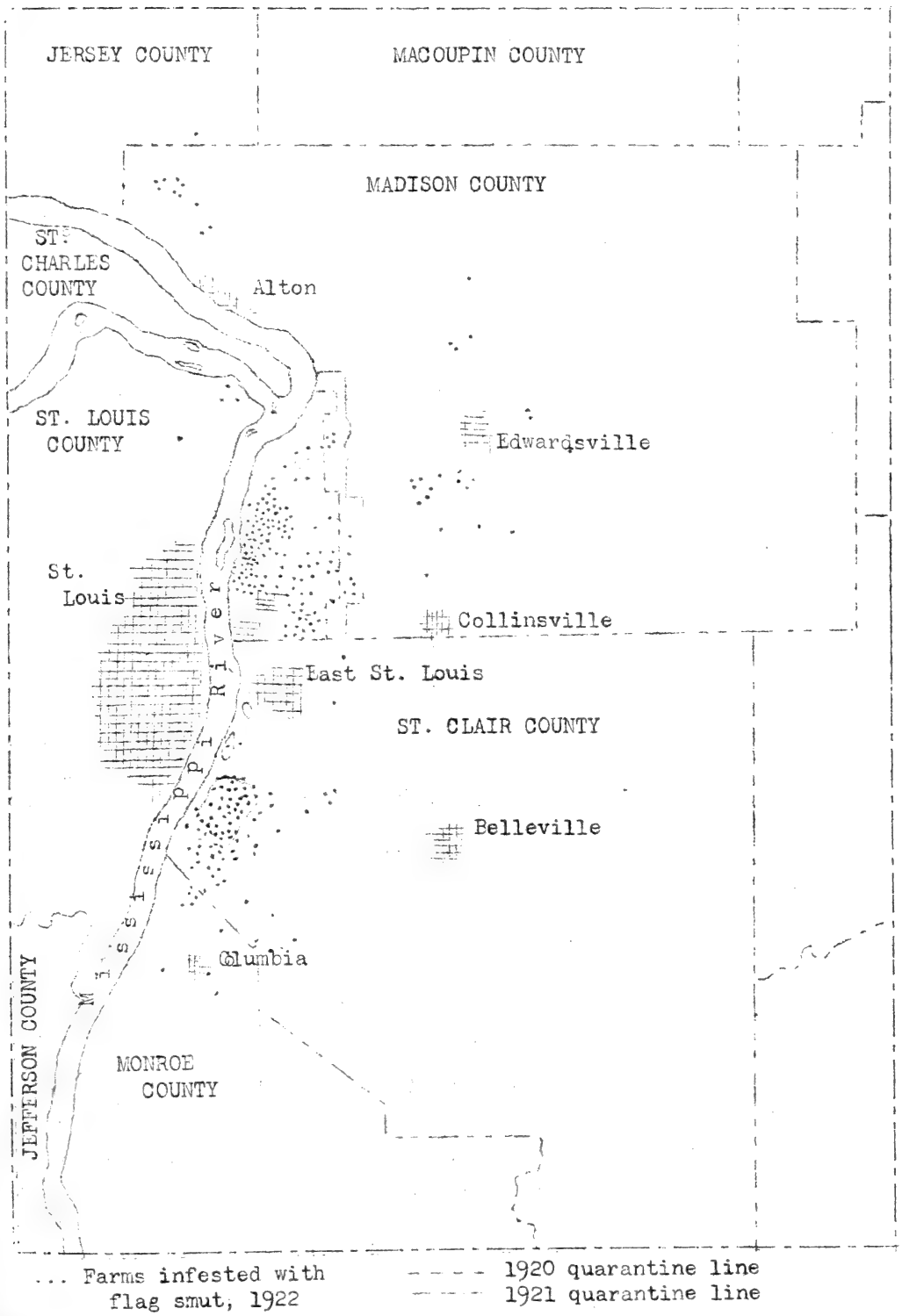


Fig. 19. Present known distribution of flag smut of wheat.

WHEAT - Flag smut

Flag smut caused by Urocystis tritici Koke.

At the close of the wheat season of 1921 flag smut was known only in the western part of Madison and St. Clair Countiies, Illinois. During that year careful search for the disease, on both sides of the Mississippi River from Cairo, Illinois to St. Louis, Missouri and in parts of the Missouri and Illinois River valleys had resulted in the discovery of an infested area where the flag smut was present in 57 infested fields on 30 farms in St. Clair County, Illinois. In addition to this the original Granite City or Madison County section had been enlarged and extended further by the finding of 100 more infested fields.

Flag smut survey in 1922: In the survey for flag smut in 1922 the following agencies co-operated: The Illinois State Department of Agriculture, the Missouri Agricultural Experiment Station, the Illinois Natural History Survey, and the U. S. Department of Agriculture represented by the Plant Disease Survey and the Office of Cereal Investigations. In all over 1200 farms were examined in Madison, St. Clair, Monroe, Jersey and Macoupin Counties, Illinois, and in St. Louis and St. Charles Counties, Missouri.

As a result of the survey the area of known infestation was increased from 72 to about 700 square miles. Two new Illinois counties were added to the list of those in which the disease occurs and the smut was discovered for the first time in the State of Missouri on four farms in St. Louis County, opposite the infested area in Madison County, Illinois. The area where the disease is now known to occur, roughly speaking, occupies a strip about 50 miles long from 5 to 1 miles wide along the east bank of the Mississippi from southern Jersey to northern Monroe County. The smut was found on about 226 farms, the approximate location of which is shown on the accompanying map (Fig. 19). Approximately 283 of the farms inspected were within the quarantined area of last year and of these 155 or 55% were found to have flag smut. Outside of the 1921 quarantine zone, flag smut was found on 71 or 8% of the 900+ farms inspected. Since the work in the various localities was done by different groups of men, it seems best to report more detailed results according to the following sections: (1) inside the Madison County area, (2) outside the Madison County area, (3) work in St. Clair and Monroe Counties, and (4) survey in Missouri.

1. Inside the Madison County area:

> "Every wheat field within the quarantined area was inspected for flag smut.....The disease was found quite generally throughout the area in amounts ranging from the slightest trace to as high as possibly 2%. The entire planting inside this zone was supposed to be of two varieties, Red Wave and Turkey 10-110, the seed being obtained from sources outside the quarantin and treated at the central dipping plant with copper sulphate and lime. The total wheat planted in the area was about 12,600 acres, 10,500 being Red Wave and 2100 Turkey 10-110.
>
> "In the Red Wave, 32 infections were found on ground which was in wheat the year previous; 48 on ground, part of which was in wheat the previous year and 10 on ground not in wheat the year before." (H. B. Waterbury, in charge of Illinois State Department of Agriculture in Madison County.)

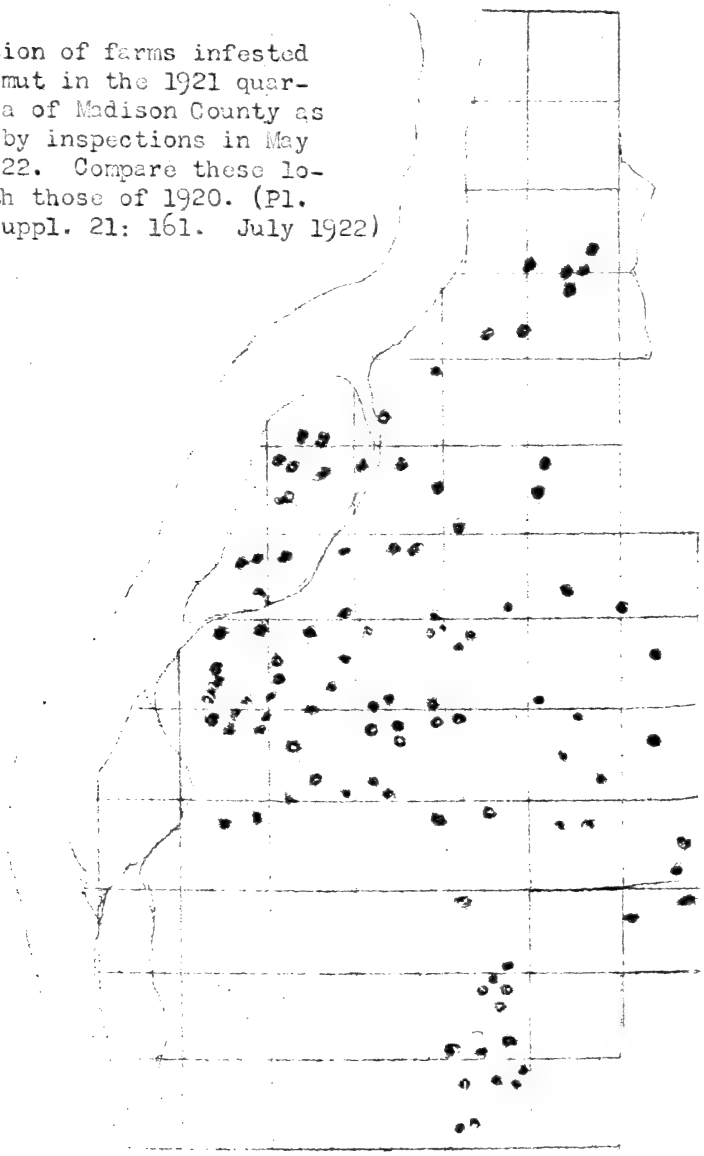


Fig. 20. Location of farms infested with flag smut in the 1921 quarantined area of Madison County as determined by inspections in May and June 1922. Compare these locations with those of 1920. (Pl. Dis. Bul. Suppl. 21: 161. July 1922)

2. Outside the Madison County area: About 270 farms were inspected and 30 of these, distributed over an area of approximately 240 square miles, were found infested. This area added to that under quarantine makes an area of approximately six times that known to be infested in 1921. Infections were found as far as 12 miles outside of the quarantined area. Regarding the work in this territory, R. D. Rands, representing the U. S. Department of Agricultue, reports as follows:

"In judging the results of the inspection work the extent to which flag smut has been found in these outposts of infection should be borne in mind. In most fields it was a mere

trace, not easily expressed on a percentage basis. In limited areas in the vicinity of straw stacks in two cases and along borders or in portions of some fields where there was apparently an accumulation of infected material from washing of the soil, infections of 5-30% were recorded. On the whole, therefore, it is evident that with but a limited time for examining particular fields inspection alone as a means for determining the presence or absence of the disease is an uncertain method."

Considerable evidence was obtained showing that the threshing machine, in addition to the seed and wind, is important in disseminating the spores of flag smut. Regarding this, Rands states:

"That thrashing machines are a common carrier of this smut from farm to farm, just as they are known to distribute bunt spores, wild onions, cockle and volunteer rye, is probable if we may judge from our success in locating advance infections by following threshing runs. For example, we have frequently found flag smut on farms surrounded by apparently disease-free ones, located long distances from the nearest known infection where the farmer had for many years used his own wheat for seed, but usually where an infected crop had been threshed ahead of his in another part of the same run. While it is of course possible that the smut was carried to such farms by wind or other agents, it seems more likely that the threshing machine or bundle wagon were responsible. Out of 8 infected threshing runs located 1-1/2 to 13 miles outside the quarantine border, a fairly even distribution of flag smut throughout the run was shown in five. The other three were only partially infested so that after finding it in the first portion of each of these runs, no more farms were at the time inspected."

3. Work in St. Clair and Monroe Counties:

"Within the St. Clair quarantined area of 1921 there were 3,398 acres in wheat this year, This comprised 194 fields, 87 of which were infested with flag smut, the degree of infestation ranging from a trace to as high as 22% in parts of fields where the infection was heaviest. Of these 87 infested fields, 74 were in wheat last year and the remaining 13 fields were in crops other than wheat.

"Within the quarantined area the infestation appears to be lighter than it was last year. In certain fields that were heavily infested last year and were in wheat again this year, fewer infected plants were found than were found last year.

"Outside of the area quarantined, several hundred farms were inspected, on 24 of which flag smut was found. The degree of infection in these ran from the merest trace to the heaviest infection which was found, 30% in a part of one field, which lay just outside of the old quarantine area.

"As we inspected further from the quarantined area, the infestation became progressively lighter, both as regards the number of fields infested and the number of plants infected. Some of this smut material was evidently carried by threshing machines into this area. The results of our inspection indicate that we have reached

the limits of the infested area." (James S. Conard, In Charge of the Illinois Department of Agriculture Survey, St. Clair County).

4. Survey in Missouri: Flag smut was found by Dr. E. F. Hopkins on June 8 on a farm near the junction of the Missouri and Mississippi Rivers, St. Louis County, Missouri. This farm was on bottom land that overflowed when the river was at its greatest height. A few days later the disease was discovered by the Plant Disease Survey men on three other farms in the uplands. From a survey of the conditions that might have brought about the introduction of the disease into this locality, it appears that spores were either blown across the Mississippi River by the wind or came in on seed from St. Louis.

1922 quarantine measures: The areas in Illinois where the disease was found were put under quarantine and the following restrictive measures required: (1) Disinfection of wheat with formaldehyde at the threshing machine. (2) The requiring of elevators, mills, or dealers in wheat to see to it that all wheat from the infested area is disinfected before shipping to other persons or dealers inside the counties of Madison, St. Clair, and Monroe. (3) Restrictions on the movement of wheat straw outside the area. (5) Regulations regarding the movement, disinfection, and operation of threshing machines.

Stem rust caused by Puccinia graminis Pers.

Taking the United States as a whole, the year of 1922 can be considered as one during which the losses from stem rust were not especially great. In general there was less stem rust in 1922 than in 1921. Of all the collaborators reporting the disease, none regard it as worse than last year, and only five (Pennsylvania, West Virginia, North Dakota, Kansas, and Oklahoma) mention it as being of the same prevalence as in 1921. The only states where the disease was considered of much importance were Texas, where the rust winters over, Oklahoma, and in the spring wheat states. As usual, the damage occurred mostly in the hard red spring wheat area, the heaviest losses taking place in eastern North Dakota and western Minnesota where reduction in yields of 10% and 5%, respectively, were recorded. Cass County, North Dakota, seemed to be the center of the damaged area. In that County alone it is estimated that about one quarter of the wheat crop was destroyed on account of black stem rust. In Wisconsin, spring wheat that was planted late was badly damaged. The other spring wheat states - South Dakota, Nebraska, and Iowa - suffered somewhat but to a much less degree.

The accompanying map shows the estimated average reductions in yield, according to collaborators. It will be noted that most of the recordable losses occurred in the barberry eradication area and that the states in the western part of the area suffered practically no loss from the disease. Outside the eradication area it will be seen that 10% loss was reported from Texas where the disease wintered over and, starting early, spread northward to some extent. It is undoubtedly true that considerable loss took place in Oklahoma, but estimates are not available for that state. Of the other states, only Maryland, Arizona, and Utah estimate any recordable damage.

The following statements from collaborators give information concerning the prevalence and destructiveness of stem rust during 1922:

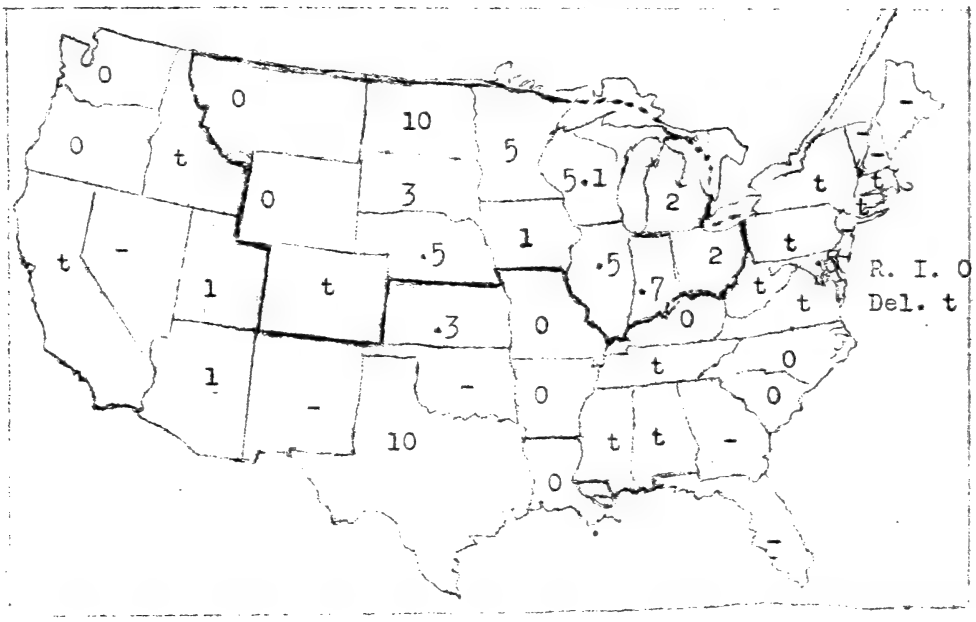


Fig. 21. Estimated average loss from stem rust of wheat, according to collaborators, 1922. Barberry eradication area is shown on this map.

Kentucky: Occurred rather widely over the state, but too late to cause appreciable loss. (Valleau)

Ohio: By June 20 stem rust of wheat near infected barberry bushes had become heavy. In some of these instances the yield will be much reduced. On this date a trace of stem rust of wheat could be found in widely separated sections of Ohio. Farmers were cutting wheat in central Ohio during last two weeks of June. (Cereal Courier 14:(15): 162. 1922)

Indiana: Less than last year. Severe only near barberries. Four bad areas and two minor outbreaks. (Gardner)

Illinois: Infection this year throughout the state, but the total very small. There will probably be very little recordable damage. (Tehon, July 15)

Michigan: Stem rust not as yet common in fields though wheat is in hard dough stage. A few cases found, but these were close to barberry and already in teliospore stage. (Coons, July 12)

Wisconsin: Observed in all sections of winter wheat. Majority of crop matured before much damage was done. Late planted spring wheat was badly damaged. Did not see any fields without stem rust. (Vaughan)

WHEAT - Stem rust

Minnesota: Winter wheat was matured early in July. The amount of infection varied. In most fields it ranged from 5-10%. A few fields were found in Goodhue County in which as many as 25% of the plants were infected, but rust too late to do much damage. In spring wheat considerable rust occurred in many sections of the state. (Sect. Plant Path.)

Iowa: Only a trace on winter wheat, less than I have seen any time during the last seven years. (Melhus, July 15)

Missouri: Very little stem rust was reported in Missouri this year. None was noted in the vicinity of Columbia and only a few spot infections have been found in other places in the state. (Hopkins, July 15)

North Dakota: Rust did severe damage in southeastern portion of the state in an area comprising perhaps one-seventh of the total area of the state. (L. R. Waldron, September 1)

I covered a good part of Cass County and saw a lot of damaged wheat both, Marquis and durum. Latter was rusted badly again this year. The infection seems worse than in the last several years, but the damage may not be as much as most of the wheat is pretty well ripe. All late wheat will be hurt badly. The rust goes west to about Jamestown in damaging amounts, but there is plenty of infection farther west. (J. A. Clark. Cereal Courier 14: 230, August 10, 1922)

Winter wheat matured during first half of July. The amount of stem rust infection varied, but in general was small. There are many fields of Marquis wheat in the southeastern part of the state which are showing 70-100% infection of rust. Wheat harvest is not quite completed in this section. (Wanda Weniger, August 15)

Judging by our county yield figures for both durum and hard wheat in the counties where rust was prevalent, I would say that Cass County is the only one where a 25% loss could have resulted. The southeastern group of counties will average 25% below the state yield, but it was in this district that drouth was also a factor, if not the principal cause. (J. G. Diamond, Agricultural Statistician, Grand Forks, North Dakota, December 2, 1922)

South Dakota: Rust remarkably abundant, but very little damage due to late start. (Evans)

Nebraska: Slight scattered infection, much less than 1921. (Peltier)

Kansas: In a few counties very heavy infection occurred. Traces occurred in practically all of the chief wheat growing counties. (Melchers, July 15)

Montana: Rust did not appear until so late in the season that the crop was beyond the danger point. (Swingle)

Wyoming: Rust has not been found in this state this year. (R. U. Cotter, Cereal Courier 14: 243. August 21, 1922)

Colorado: Quite prevalent in some sections of the spring wheat growing area. It was especially common on Marquis. Where it was late sown it will be damaged to some extent. (Learn, August 1)

Most of the grain of Colorado has been harvested, and we are pleased to report only a small loss from black stem rust. (J. R. Fitzsimmons, Cereal Courier 14: 295. September 20, 1922)

Alberta, Canada: Very little rust was observed on early sown grain. On very late grain a few pustules were present. A little rust was present on heavily irrigated plots at Lethbridge. None could be found on very late seeded wheat at Lacombe. (G. E. Delong in Canadian plant disease survey report, 1922)

Saskatchewan, Canada: Late in the season rust was present at Edmonton on very late wheat but the main crop showed no rust. There was considerable development of rust in southern Saskatchewan, but little injury was done. (W. P. Fraser in Canadian plant disease survey report, 1922)

Manitoba, Canada: Stem rust was very irregular this year throughout the Province. It would be difficult to account for the severity in some parts and absence in other parts. (V. W. Jackson in Canadian plant disease survey report, 1922)

New Brunswick, Canada: It did not appear to be so active or abundant in 1921 and 1922 as in previous seasons, possibly on account of dry summers. (G. E. Cunningham in Canadian plant disease survey report, 1922)

Prince Edward Island, Canada: Prevalent to greater extent than last year and in many cases crop was severely attacked. J. B. McCurry in Canadian plant disease survey report, 1922)

Table 69. Estimated losses from stem rust in barberry eradication area, 1918-1922, inclusive. (Pl. Dis. Bul. Supplements 6, 12, 18 and 24)

State	Percentage stem rust					
	1918	1919	1920	1921	1922	Average
Ohio	.1	1.	t	6.	2.	1.82+
Ind.	t	1.	.1	1.	.7	.56+
Ill.	t	1.	.5	.5	.5	.50+
Iowa	t	8.	7.	10.	.2	5.04+
Mich.	.5	8.	8.	5.	2.	4.70
Wis.	.5	15.	30.	10.	5.1	12.12
Minn.	.1	20.	30.	7.	5.	12.42
N. D.	-	20.	20.	10.	10.	12.00
S. D.	.7	10.	20.	10.	3.	8.74
Nebr.	t	10.	12.	t	.5	4.50+
Mont.	-	*0.	0.	2.5	0.	.50
Wyo.	-	-	t	*	0.	+
Colo.	-	1.	1.	t	t	.40+

WHEAT - Stem rust

Weather relations

A considerable number of collaborators and others mention weather conditions as the reason for the comparatively small amount of damage in 1922 as compared with other years. Although a number of different weather factors are mentioned as being influential, the majority of them seem to agree that in many places at least dry, warm weather held the rust in check and hastened maturity of the grain so that the wheat escaped. In North Dakota it was mentioned that a warm May advanced the wheat crop so that even under favorable conditions for stem rust late in the season, the grain matured before great damage could be done. In Minnesota it was mentioned that cool weather held the disease in check. The following comments from collaborators and others on this subject are given:

West Virginia: Probably checked by dry weather during latter stage of heading. (Giddings and Sherwood)

Minnesota: Moderate infections throughout the Red River Valley, but in general the weather was too cool for the rust to do much damage. (Sect. Plant Path.)

Iowa: Dry weather has effectively checked stem rust. Most of the wheat is harvested and only a trace of damage. (Muncie, July 15)

North Dakota: Another thing that tended to save the crop over a good proportion of the state this year was probably the extremely warm weather for growth during May. If the temperature during May had been normal (it was several degrees above normal) the grain at the time when rust arrived would have been perhaps ten days later in development than it was. (L. R. Waldron, September 1)

South Dakota: The fore part of July was dry and tended to inhibit rust development. If the last of June and first half of July had been moist, I believe it would have been exceedingly destructive. (Evans)

Nebraska: Wheat harvest earliest on record due to dry weather causing early maturity. (Peltier, June 26)

Kansas: Warm weather with lack of rain checked what might have been an epidemic. Infection in a light form was present early and would undoubtedly have spread rapidly had climatic conditions not interfered. (Melchers)

Montana: Weather conditions in most parts of the state have been favorable to the development of rust but it did not appear until so late in the season that the crop was beyond the danger point. (Swingle)

Colorado: Drier weather than usual and temperatures above normal. (Learn)

Arizona: Year unfavorable for development. (Brown)

Washington: On account of the dry season rust has not shown up on grain to any appreciable extent. (Dana, August 15)

Oregon: Long drouth has prevented any development although present throughout the state in small quantities. (Barss)

Alberta, Canada: The weather was very dry in central and northern Alberta during the season and plant diseases were even less than usual. Very little rust was observed on early sown grain. (G. E. Delong in Canadian plant disease survey report, 1922)

Saskatchewan, Canada: But little injury was done by stem rust this season. This was probably due to the dry weather that prevailed in July. (W. P. Fraser in Canadian plant disease survey report, 1922)

Notes from the 1922 rust epidemiology studies -- by E. B. Lambert and E. C. Stakman.

"The stem rust situation was closely watched this year throughout the central Mississippi Valley from Texas to Canada. Overwintering of stem rust was observed in southern Texas and strong circumstantial evidence of overwintering was obtained in northern Texas at Denison. The rust in Texas began to accumulate in April, so that by May 15 it was general throughout the central portion of the state. In June the infection reached ten to forty percent in the northern part of the state, with considerably less rust in the southern areas. Observations at harvest time placed the damage in northern Texas at about ten percent.

"By June 1 general field infection had reached the northern boundaries of Kansas and Missouri and had extended over into the southern portions of Indiana. In Missouri a number of observations were made during June. Although the general infection was light, a peculiar spotted condition of the fields, with regard to the presence of stem rust, was observed in several localities. Spots ranging from ten to thirty feet in diameter were found to be heavily infected, while the surrounding fields were only slightly rusted. This condition was probably due to overwintering urediniospores or to wind-blown spores.

"On June 1 rust had already appeared on cereals and grasses near barberries throughout practically the entire barberry eradication areas, with the exception of western North and South Dakota, Wyoming, and Montana. For example, at Northfield, Minnesota, on June 6, rust was observed to have spread for at least a mile and a half from barberries, traceable directly to aeciospore infection. In this location, where a careful study was made, there was twenty-five to one hundred percent infection on all of the plants at three-fourths of a mile distant from the bushes. The spread of rust was later definitely traced from this planting to a distance of three miles.

"Stem rust was first reported spreading from barberries to grains or grasses on the following dates: Nebraska, May 22; Minnesota, May 26; Ohio, May 27; Colorado, May 28; Wisconsin, June 1; North Dakota, June 2; Michigan, June 3; Illinois, June 8; New York, June 10; and Montana, June 23. Listing these states in the same order, rust was first reported from barberries as follows: Nebraska, June 2: Minnesota, June 17; Ohio, June 30; Colorado, June 15; Wisconsin, June 29; North Dakota, June 13; Illinois, June 8; New York, July 6; and Montana, June 30.

"In the spring wheat area there was a general epidemic of stem rust this year. However, severe damage was confined to small local areas, owing to the fact that the rust did not become heavy until the grain was about ready to harvest. While this year's evidence indicates that the inoculum from the barberries alone could have produced the entire eopdemic, it is also possible that southern blown spores may have contributed a share of the late infection.

"All of the work which was done early in the season, however, indicated that the epidemic of rust which occurred in the north came principally from barberries. It was quite significant that the number of urediniospores of black stem rust decreased rather rapidly as the distance from known areas of rust infection increased. For instance, early in the spring an area was found near Denison, Texas, in which there was fairly heavy rust. By means of exposing spore traps on aeroplanes it was found that the number of spores near the rusted area was rather large but that the number diminished rather rapidly as the distance from this area increased. While viable urediniospores can be found in the air, and while some of them undoubtedly are carried long distances, it would appear that the process of spread of the rust from the south to the north by means of wind-blown urediniospores probably would be so slow as to make it rather difficult for an epidemic to develop in the north if the barberries were eradicated."

Barberry eradication

Dr. F. E. Kempton (2) reports as follows concerning the barberry eradication campaign:

"In the barberry eradication campaign conducted co-operatively for five years by U. S. Department of Agriculture and 13 north-central states, marked progress has been made. During 1922, the survey covered 200 counties. This includes 16 counties in Minnesota and one in Iowa surveyed on State funds. In these counties, 186,672 bushes were located on 5,278 properties, and 696,517 bushes were removed from 5,799 properties. Of 275 counties previously surveyed, 201 were completely resurveyed in 1922, and 84,142 sprouts were found and removed.

"During the five years, 1918-1922, practically all cities and villages of the 13 States have been covered once and resurveyed in part, and 475 counties have been completely covered. This includes 40 counties surveyed on funds furnished by States. In the 5 years, 2,066,541 bushes have been found in cities and villages and 3,740,102 on farms, making a total of 5,806,643 bushes found, of which 5,140,343 have been removed."

The problem of the sprouting up of new plants from portions of roots left in the ground is proving to be a very important one in the campaign. Regarding this Kempton states (Cereal Courier 14: 403, Dec. 31, 1922):

"A complete resurvey has been made in 201 of the 276 counties surveyed in previous years, and a resurvey also has been made in all cities and towns covered in the original farm-to-farm survey. In this resurvey, 88,740 sprouts and thousands of seedlings were found and removed during the past year. It has become evident that several resurveys will be necessary. If the entire root system is not removed when barberry bushes are dug, sprouts may grow even from small bits of the roots which are left in the soil. To go back after a bush has been dug and find all of these sprouts is difficult and expensive. Furthermore, it is almost impossible to remove all of the

roots which have entwined with the roots of trees or which have grown into the crevices between rocks."

N. F. Thompson (4,5) has conducted experiments with the use of chemicals for killing barberry bushes. About 40 different chemicals have been tried and two of them, rock salt and sodium arsenite have given uniformly good results, being available, cheap and effective. About ten pounds of rock salt is piled around the base of the barberry bush at any time of the year and complete death of the plant is practically certain.

Many more escaped barberry bushes have been found than were expected when the campaign was started. Regarding this question, Kempton states (Cereal Courier 14: 403. Dec. 31, 1922).

"The spread of escaped barberries to open woodlands, fence rows, rocky ledges, brushy pastures, and stream banks has become the most serious problem of the campaign. During the past year, 133,365 escaped bushes have been found on 830 properties. The great number of these were in the States of Michigan, Ohio, Illinois, Wisconsin, Minnesota, and Iowa. During the entire campaign, 3,760,351 barberries were found on farms, only 331,801 of which were cultivated while 3,428,550 have been escaped bushes. These areas are being carefully mapped in order to facilitate the complete eradication of seedlings and sprouts. All bushes in representative areas in Iowa, Wisconsin, Illinois, Michigan, and Ohio have been treated either with rock salt or sodium arsenite as trials of that method of eradicating escaped barberries."

Varietal susceptibility

J. Allen Clark reports (Cereal Courier 14: 41. March 31, 1922):

"Since the discovery of rust resistance in Kanred and Kota these high quality varieties of common wheat have been used as rust-resistant parents, which has made it unnecessary to rely upon the durum wheats for obtaining rust resistance..... An extensive series of hybrids made between Marquis and Kanred in 1917 and 1918, with the object of producing a spring wheat with the qualities of Marquis and the rust resistance of Kanred, has produced promising material.....

"Crosses made in 1919 and 1920, between the rust-resistant Kota, and Marquis and Ruby, offer unusually good possibilities for obtaining the desired types..... Several other crosses for rust resistance have been made, including the cross of Kanred and Kota, which combines the two varieties that are resistant to many of the forms of stem rust. An attempt is being made to develop, synthetically, strains of spring wheat resistant to all biologic forms of stem rust. (Cooperative wheat breeding experiments between U. S. Office of Cereal Investigations and the Minnesota Agricultural Experiment Station)

O. S. Aamodt (1) in his paper at the Boston meeting reports further concerning the work of crossing Kanred and Marquis.

Melchers and Parker(3) in their recent bulletin have reported that out of the 100 varieties and strains of winter wheat tested, all of them were found to

be susceptible to stem rust except Kanred and two very similar pure-line selections, P1066 and P1068. Another pure-line strain, Kansas No. 2390, gave evidence of being partially resistant. Several varieties of spring wheat proved rust resistant under the conditions of their experiments, though the Black Persian was the only spring wheat variety of the common or bread wheat group which was found to be resistant. Of the varieties of durum or macaroni wheat, Beloturka (C. I. No. 1513), Iumillo (C. I. No. 1736), Kubanka (C. I. 2094), Monad (D-1), and Pentad (D-5) showed definite signs of resistance to stem rust. A hybrid of Iumillo x Preston, resembling the durum parent, also was found to be rust resistant. All of the strains of emmer and einkorn grown gave some evidence of resistance.

Literature (Cited):

(1) Aamodt, Olaf. Correlated inheritance in wheat of winter-spring habit of growth and rust resistance. (Abstract) Anat. Rec. 23: 89-90. 1922.

(2) Kempton, F. E. Progress in barberry eradication. (Abstract) Phytopath. 13: 48. Jan. 1923.

(3) Melchers, L. E. and J. H. Parker. Rust resistance in winter-wheat varieties, U. S. Dept. Agr. Bul. 1046: 1-32. May 1922.

(4) Thompson, Noel F. Eradicating the common barberry by means of chemicals. (Abstract) Phytopath. 13: 48. Jan. 1923.

(5) _____ Results of experiments in chemical destruction of the common barberry. Proc. Sec. Ann. Conf. Prev. Grain Rust 1922: 18-21. Nov. 14, 1922.

(Not cited):

Allen, Ruth F. A cytological study of infection of Baart and Kanred wheats by Puccinia graminis tritici. Journ. Agr. Res. 23: 131-151. Jan. 1923.

Hursh, C. R. The relation of temperature and hydrogen-ion concentration to urediniospore germination of biologic forms of stem rust of wheat. Phytopath. 12: 353-361. 1922.

Kempton, F. E. The barberry eradication campaign progress during 1922. Proc. Second Ann. Conf. Prev. Grain Rust. 1922: 13-18. Nov. 14, 1922.

Poltier, G. L. A study of the environmental conditions influencing the development of stem rust in the absence of an alternate host. Nebr. Agr. Exp. Sta. Res. Bul. 22: 1-15. Sept. 1922.

Stakman, E. C. Fighting rust in Europe. Proc. Sec. Ann. Conf. Prev. Grain Rust, 1922: 21-28. Nov. 14, 1922.

_____ and M. N. Levine. The determination of biologic forms of Puccinia graminis on Triticum spp. Minn. Agr. Exp. Sta. Tech. Bul. 8. 1-10. July, 1922.

Waterhouse, W. L. On the production in Australia of the aecidial stage of Puccinia graminis. Jour. Roy. Soc. N. S. W., 55: 1-10. Mar. 9, 1922.

Leaf rust caused by Puccinia triticina Eriks.

Regarding the distribution and severity of leaf rust in 1922, Dr. E. B. Mains, who has been investigating this disease with the Indiana Experiment Station and the U. S. Office of Cereal Investigations reports as follows:

WHEAT - Leaf rust

"The leaf rust of wheat, Puccinia triticina, has been unusually severe this year throughout most of the eastern United States. The rust has been heavier over a wider area than in any year since investigations were started in 1918. In addition to the territory covered with heavy development of leaf rust last year, which comprised North Carolina and Tennessee to Kansas northward, the Southern states have suffered considerably, especially Georgia and South Carolina.

"Observations since 1918 would indicate that the territory included in a strip running from Maryland and North Carolina westward through southern Ohio, Indiana, Kentucky, Tennessee and Kansas, is apparently rather uniformly subject to heavy annual epidemics of leaf rust, the territory to both the south and north escaping some years with only a moderate or light epidemic."

A summary of the reports of Plant Disease Survey collaborators shows that leaf rust was especially severe in 1922. It was rated as more prevalent than in 1921 in New York, Virginia, West Virginia, South Carolina, Georgia, Indiana, Illinois, Kansas, and Minnesota, and it will be recalled that 1921 was a bad year for leaf rust throughout central eastern United States. The following states list leaf rust as being the most important disease of wheat in 1922: New York, Delaware, Maryland, Virginia, West Virginia, South Carolina, Indiana, Illinois, Tennessee, Mississippi, Oklahoma, and Arkansas. The states of Pennsylvania, Georgia, Ohio, Wisconsin, and North Dakota report leaf rust as being the second disease in importance.

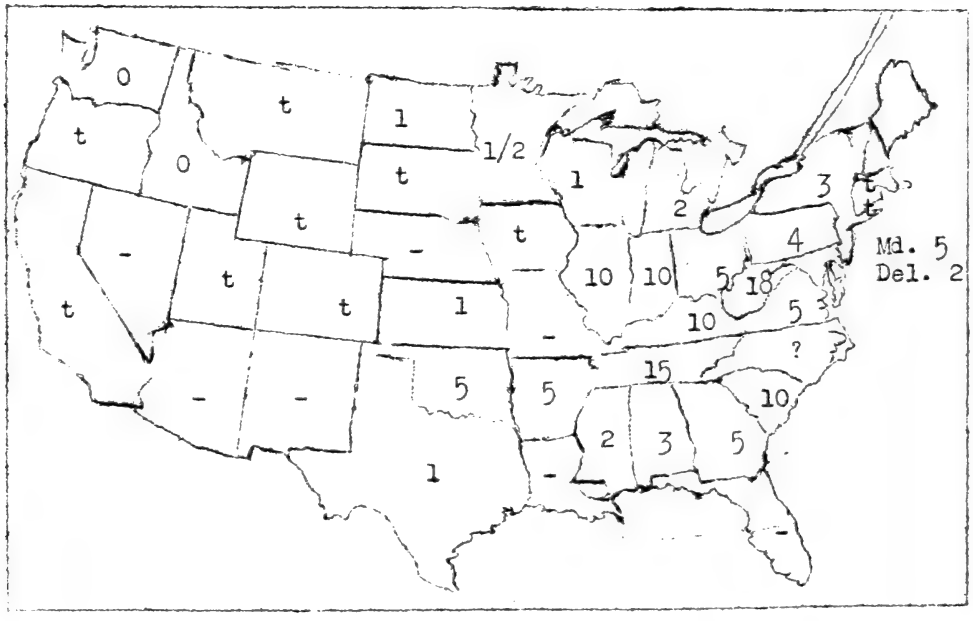


Fig. 22. Estimated losses from leaf rust of wheat, 1922.

The accompanying map shows the estimated reduction in yield from leaf rust

according to collaborators. An examination of this map will show that the greatest losses occurred in the belt of states mentioned by Mains and in the Southern States. Dr. Mains has given considerable attention to the matter of loss, regarding which he writes as follows:

"It is of course difficult to accurately estimate the loss due to the leaf rust of wheat on account of the lack of a basis for comparison. In northern Georgia and South Carolina a number of farmers were so alarmed by the rapid and heavy development of the rust before heading time that they made inquiries as to the value of rusted wheat for hay or pasturage and as to the advisability of plowing the crop under. In all cases they were advised against such measures. When visited about May 9, the wheat in this region was very heavily rusted, especially the variety generally grown, and known as Tennessee Purple Straw. The leaves had been prematurely killed, but the wheat had headed fairly well. Mr. R. P. Bledsoe stated that the rust in the region of Experiment, became severe about March 1st, when the wheat was beginning to shoot. He estimated that the loss was likely to be 50%. He later stated that the yield on Purple Straw this year at Experiment was 14 bushels, while on similar land last year, when very little rust developed, it was 30 bushels. At Jefferson, Georgia, County Agent Hill Hosch stated that the rust became bad about March 1, when the wheat was about 1 foot high. He estimated that the loss would run from 25% in some fields up to as high as 100% in the heavier rusted. He expressed much concern over the situation since he stated that more wheat had been planted in that county this year than in the past six together. It is evident that some years in this region the leaf rust of wheat is an important factor in wheat growing. Apparently there is a desire throughout the South for better systems of farming involving the adoption of crop rotation in which the land will have crops on it in the winter which will bind the soil and prevent washing, and wheat is most to be desired for this purpose on account of the value of the crop. One of the principal obstacles apparently is the loss due to rust.

"Throughout Virginia, Tennessee, and Kentucky, the leaf rust of wheat apparently started somewhat later than last year, yet the greater severity will probably result in as much loss as was experienced in those states in 1921. In Indiana and Illinois the leaf rust of wheat was more uniformly severe over the entire state than last year, only small areas as around Lafayette, Indiana, where drought prevailed for three or four weeks before harvest showing moderate or light infestations of the disease. The loss consequently for these states as a whole is likely to run higher and the disappointing yields which have been reported from southern Indiana are probably due in large part to the general prevalence and severity of the disease there this spring. A few fields in southern Indiana have been reported by Dr. Charles Gregory as being practically a complete loss where leaf rust became heavy early when the wheat was about a foot high. The loss for the southern part of Indiana, as estimated by members of both the Soils and Crops and Botany Departments, was placed at about 20%, while for the state as a whole, it was considered as averaging in the neighborhood of 10%. Dr. Gregory has arrived at similar conclusions by taking the dif-

ference shown between the May estimate in the Indiana Crop Reporter and the actual yield in August and dividing this among the different factors producing reduction in yield.

"In greenhouse experiments, losses as high as 40% have been obtained under conditions of heavy infection starting about heading time. Even heavier losses have been obtained when the wheat plant is rusted earlier. It may also be stated that the yield of rusted plants when taken by themselves does not create an impression of heavy loss, the grain being about as plump as the non-rusted, and of fairly good number, but the number is decidedly less than the non-rusted. I believe that in the absence of complete loss or noticeable effect on the grain, the lack of a non-rusted basis for comparison is largely responsible for the opinion, often expressed, that leaf rust does little or no damage. Part, at least, of the decrease in yield attributed to weather probably is due to this rust."

Attention is called particularly to the statement by Mains that as high as 40% reduction in yield has been obtained by experimentally infecting plants with leaf rust and that the loss is not evidenced by shriveled grains but by a reduction in the number of kernels. It is thought that the production of sound grains in wheat heavily infested with leaf rust has led to the belief that the disease was not of a serious nature.

Varietal susceptibility

Mains reports as follows concerning the susceptibility of varieties:

"One thing very noticeable this year has been the increase in susceptibility of a number of the varieties which in previous years had shown high resistance, many varieties being only moderately resistant, where before they had shown a high resistance. Thus several strains of Turkey, Beloglina, Kanred and some of the spelts and durums showed higher percentages of leaf rust this year than hitherto, the presence of hypersensitiveness in most cases indicating that there was not a complete loss of the resistant character. Otherwise most of the strains reported as resistant last year have shown high resistance in one or more plantings. In addition a number of other varieties have been observed showing resistance. These include a durum in the variety nursery of R. P. Bledsoe, at Experiment, Georgia, several Italian wheats grown by Prof. Essary at Knoxville, Tennessee, and a number of spring wheats in the nursery of J. G. Dickson at Madison, Wisconsin, especially Acme, Huguenot, Medeah, Iumillio, Saragolla, Kubanka, Black Don, Vernal Emmer, Einkorn, and some 80-100 unnamed selections mostly Algerian.

"Although Kanred has not been quite as highly resistant this year, yet Dr. Leighty and myself have been able to make some very promising selections in the F_2 generation of hybrids made by Dr. Leighty between Kanred and some 24 of the principal soft winter varieties. About 800 such selections have been made and many of them show considerable promise of combining the resistance of Kanred with the desirable characters of a soft or semi-hard eastern variety.

"All of the work is complicated by the presence of strains in the leaf rust resulting in certain varieties showing considerable difference in susceptibility in two different localities, some being immune at one place and rusted 70-80% at another, as for instance, Malakoff C. I. 4898. This, of course considerably complicates the work of controlling leaf rust with resistant varieties. Twelve of these strains have been differentiated in the greenhouse and 31 varieties have been found to have this differential character, resistant to some and susceptible to others. No variety has been found which is immune in the seedling stage to all of these strains, but also no culture of leaf rust has been sown to which some of these varieties are not either immune or resistant so that there is hope of obtaining a generally resistant variety by hybridization."

Melchers and Parker (3) made observations at Manhattan, Kansas for the five-year period from 1915-1919, inclusive, showing that the three pure lines of Crimean wheat, Kanred, P1066, and P1068, are remarkably resistant to leaf rust as it occurs in Kansas. They state that the resistance has been manifested also in experimental field sowings in a number of other states and in New South Wales, Australia. They do not claim, however, that the resistance of these varieties will be absolute under all conditions or in the presence of all biologic strains of leaf rust.

Collaborators in New York and Oklahoma report resistance in Kanred; Giddings, in West Virginia, noted that Gladden wheat is especially susceptible; Weniger, in South Dakota, reports common wheats as generally not severely infected, but Kota and some durums are quite susceptible; Vaughan, in Wisconsin, reports as follows, under date of July 1:

"Much more noticeable on beardless winter wheat than bearded selection at Marshfield and Ashland Branch Experiment Stations. Wisconsin #408, which has been disseminated by the Agronomy Department, shows a high degree of leaf rust resistance when compared with all other winter wheat selections grown."

Literature (Cited)

(1) Dufrenoy, Jean. La selection des blés résistant aux rouilles. Rev. Gen. Sci. Appl. et Pur. 33: 81-83. 1922.

(2) Mains, E. B. and H. S. Jackson. Strains of the leaf rust of wheat, Puccinia triticina, in the United States. (Abstract) Phytopath. 13: 36. Jan. 1923.

(3) Melchers, Leo E. and John H. Parker. Rust resistance in winter wheat varieties. U. S. Dept. Agr. Bul. 1046: 1-32. May, 1922.

Stripe rust caused by Puccinia glumarum (Schm.) Erikss. & Henn.

Collaborators in Montana and California reported stripe rust as present in 1922, but in slight amounts. From California, W. W. Mackie reported:

"Stripe rust was very scarce this year. In the grass garden at Berkeley stripe rust over-wintered and over-summered, causing an increased number of hosts to show attack. Some of these hosts were wild grasses outside the plots."

WHEAT - Stripe Rust

The Office of Cereal Investigations has contributed the following statement and map (fig. 23) taken from a recent report on the stripe rust situation by C. W. Gungerford of Idaho:

Fig. 23. Present known distribution of stripe rust (Puccinia glumarum) in the United States.

"Practically no stripe rust developed in the field during the entire season. Indeed, it has been difficult to keep cultures growing in the greenhouse due to the extremely dry and hot weather. Information secured from various parts of the Pacific Northwest and from California show that the same condition existed over this entire region. Professor Owens at Corvallis, Oregon, states in a recent letter: 'I have been unable to find any stripe rust this fall. It is the first time in years that this has been the case.' Mr. D. E. Stephens of Moro, Oregon, writes: 'Although I made diligent search for stripe rust on our grains this year, I was unable to find a single specimen. This is the first time in years that we have not had more or less stripe rust.'

"Owing to climatic conditions, only two collections of stripe rust were made in Idaho this year, one at St. Anthony on Hordeum jubatum and one at Moscow in the grass garden late in October upon Hordeum nodosum. In 1921 stripe rust was very plentiful throughout the summer months.

"A study of meteorological data for the last few years throws some light on this question. The total precipitation during the two months of September and October in 1920 was four and eighty-nine hundredths inches. The precipitation during September and October, 1921, was only two and ninety-nine hundredths inches. The precipitation during the months of September and October, 1914, was four and eight hundredths inches. The normal for these two months is only two and eighty-nine hundredths inches. The year 1915 following the wet fall of 1914 was the year stripe rust was discovered in the United States, and the rust was more plentiful according to all reports that year than any other year since, with the possible exception of 1921.

"It has been conclusively shown that stripe rust can overwinter at Moscow, Idaho, as mycelium in the tissues of various hosts. The critical time for the parasite seems to be in the late summer and early fall months. If the rust oversummers in sufficient amounts and congenial hosts are present and the weather conditions are such that the rust may develop and infect these hosts early in the fall, there will be enough overwintering of the fungus to insure a spread of the rust in the early spring. Infection later in the summer will doubtless depend to a great extent on the weather conditions in the early summer.

"During the last year it has been shown that stripe rust may overwinter at Moscow, Idaho. The rust developed on Hordeum nodosum

plants in the grass nursery on April 3, 1922, and the indications were that infection had taken place in the fall and had remained dormant throughout the winter. Snow covered these plants from December until the middle of March. Several uredinia were found on an old leaf of a seedling of the above host on that date. The infection had very evidently spread from an old scar on the leaf where a sorus had been the fall before. On April 15, a number of seedlings of this host were found infected.

"Several new hosts for stripe rust have been found during the last year. In all there are now about sixty grass hosts in addition to wheat, barley, spelt and emmer which are known to be hosts for the rust."

Recent literature

Armstrong, S. F. The Mendelian inheritance of susceptibility and resistance to yellow rust (Puccinia glumarum Erikss. et Henn.) in wheat. Jour. Agr. Sci. 12: 57-96. Feb. 1922.

Scab caused by Gibberella saubinetii (Mont.) Sacc.

During 1922 scab occurred, to some extent at least, in all of the wheat-growing states east of the 100th meridian. It was most prevalent, however, in

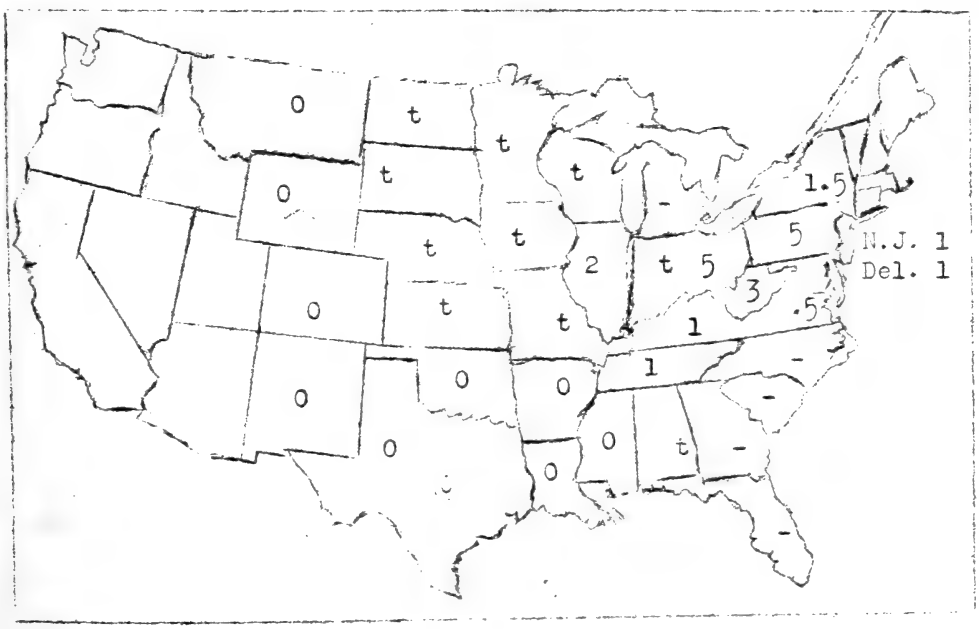


Fig. 24. Estimated percentages of loss from scab in the United States during 1922, according to collaborators.

the states along the Atlantic Seaboard from Virginia northward to New York, and in West Virginia and parts of Ohio, Kentucky, and Tennessee. In the eastern part of this general region the disease was probably even more severe than in 1919, when scab caused such severe losses throughout the eastern wheat area. From western

WHEAT - Scab

Ohio, through Indiana and westward through the remainder of the winter wheat section and also in the spring wheat areas, the disease was less prevalent than last year and caused only slight amounts of damage. The accompanying map (fig. 24) shows the estimated percentages of loss in the various states.

Some of the more significant comments of collaborators on distribution and severity of scab are as follows:

New York: Very much more than last year. (Kirby)

New Jersey: No doubt more severe this spring. (Poole)

Pennsylvania: Has been serious this year. Reports indicate losses as high as 10-12% of the crops in some fields. Generally the most important trouble of wheat this year. (Thurston)

Maryland: More prevalent than last year. Found in all fields and causing considerable loss in many of them. One field has been found with 80% of the heads infected. (Temple)

West Virginia: More than last year; of considerable importance. (Giddings)

Kentucky: Much worse than last year. The wheat scab organism appeared to be an important factor in the broken straw disease of wheat which was very destructive in Kentucky this year. (Valleau)

Ohio: Scab attack on heads of wheat was in general in Ohio during season. Counts of percentages not made in large number, but estimated infections ranged as high as 20% with 3-5% loss in yield. (Thomas)

Indiana: Less, rarely observed. (Jackson and Mains)

Illinois: Apparently not so prevalent nor so injurious as in the past years. (Tehon)

Wisconsin: Scattered late infections. (Dickson)
Less, of minor importance. (Vaughan)

Minnesota: Less, very little observed. Only trace damage. (Sec. Plant Path.)

Missouri: Much less severe this season than last. (Hopkins)

North Dakota: Less, not severe either as seedling or head blight. The disease has been markedly absent in 1922, and was only slightly present in 1921. The severe epidemic in 1919 was followed in 1920 by moderate severity. (Weniger)

South Dakota: Less than last year, did some damage which was slight, however. (Evans)

WHEAT - Scab

Dates of earliest appearance, according to collaborators:

June 5 - Illinois	June 17 - Virginia	June 24 - Minnesota
" 7 - Missouri	" 19 - New York	" 30 - Wisconsin
" 12 - Maryland	" Mid.- Ohio	" - - Delaware, South Dakota.

Weather relations in the winter wheat area.

During the last week of May and the first half of June, flowering of wheat was general in New Jersey, Delaware, Maryland, southern Pennsylvania, western Virginia, West Virginia, Kentucky, Ohio, Indiana, Illinois, Missouri, Iowa, and westward. The weather conditions during this same period were favorable for flower infection with the scab organism for the eastern part of this area, but unfavorable from central Ohio and Kentucky westward. The month of June, especially the first part of it, was extremely wet in the East, but dry in the West, according to the Weather Bureau.

The accompanying map (fig. 25) shows the areas in the eastern wheat sections where four inches or more of rainfall was reported during June. Concerning June precipitation, the Weather Bureau issues the following statement (Monthly Weather Review 50[6]: 323. June 1922):

> "In the main, precipitation was frequent and unusually heavy over most eastern districts, in fact portions of New York and New England had more rain than ever previously recorded in June. On the other hand, the month was distinctly dry in the great central valleys and portions of the far Northwest. In portions of Illinois, Indiana, Iowa, and locally adjacent states, the total fall for the month was less than 1 inch, in some instances less than half an inch, while at Chicago, Ill., it was but one-tenth of an inch, the least recorded in June for over 50 years, and similar conditions existed at other points in the Middle West."

Statements from individual states in this area concerning the June weather are as follows (Climatological Data 9[6]: June 1922):

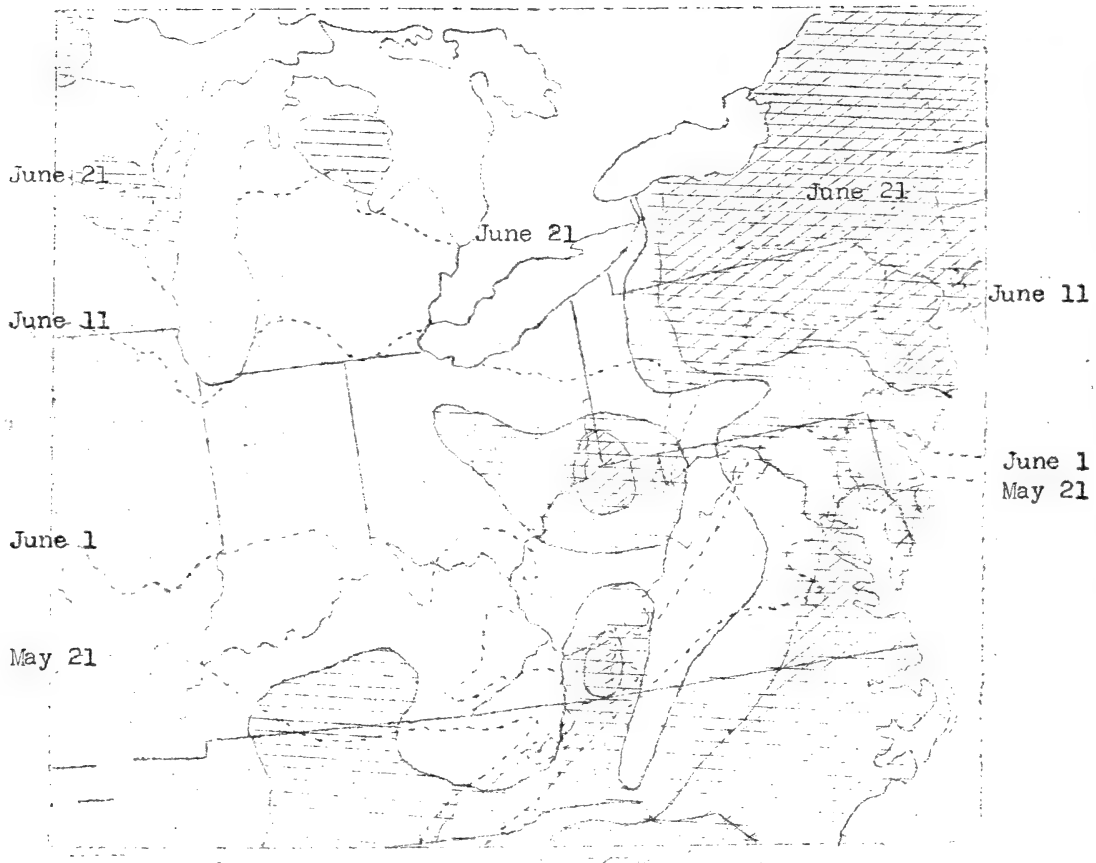
New York: "A moderate excess in temperature, deficient sunshine, an unusual number of severe local storms, and the heaviest rainfall on record, not only for June but for all months, were the outstanding features of the month."

New Jersey: "The average warmth of June, 1922, in New Jersey has been exceeded but three times, in 1889, in 1895, and in 1892, in the past 37 years. The other weather feature of the month was the persistent and copious rain which fell very generally on the first six days."

Pennsylvania: "June was a comparatively rainy month for the greater part of the state, and wet weather interfered at times with cultivation and harvesting, especially in the eastern and northeastern counties."

Delaware-Maryland: "June was warm and wet with sunshine below normal. Wheat, rye, peas, strawberries and hay were somewhat damaged by the warm wet weather of the first decade."

WHEAT - Scab



West Virginia: "June was considerably warmer and wetter than usual."

Ohio: "Temperature for the month averaged above normal and the precipitation averaged below normal, but the deficiency was not general over the state, quite a number of stations in central and southeastern counties showing an excess."

The following comments from collaborators indicate that scab was worst in the sections of the eastern states where the June precipitation was heaviest (See fig. 25).

New York: Over all parts of the state surveyed. (Kirby)

Pennsylvania: The map submitted by the Department of Botany shows greatest occurrence in the southeastern quarter of the state.

Maryland: More prevalent on Coastal Plain. (Temple & Jehle)

Virginia: Especially prevalent in southwest. Moderate injury reported from northern counties. (Fromme)

West Virginia: General, but worse in valleys. (Giddings & Sherwood)

Kentucky: Especially bad in Logan County, but scattered over all of the state. (Valleau) Logan County is in south central portion of the state.

Ohio: Worse in southern portion of state.

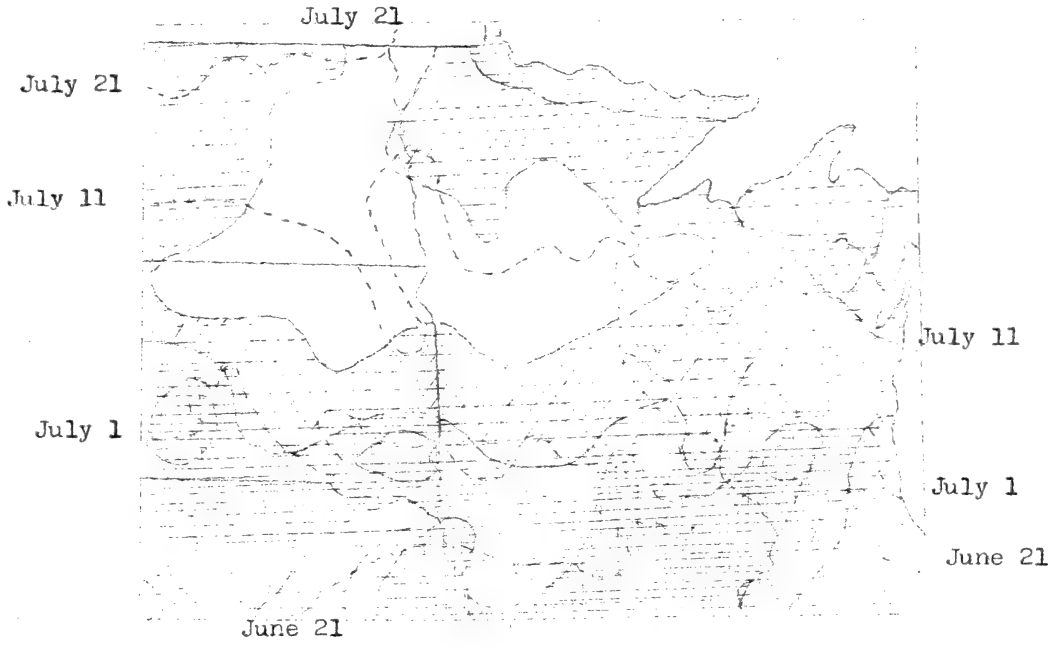


Fig. 26. July precipitation in spring wheat area.

Weather relations in spring wheat area.

The flowering of spring wheat normally is general in northern Illinois, Iowa, Nebraska, and southern Wisconsin, during the last two decades of June and in Minnesota and North and South Dakota flowering is usually general during the first two decades of July.

The June rainfall for 1922 was deficient in Illinois, Iowa and Nebraska region, with a result that only slight infection of scab occurred. The July precipitation for Minnesota and the Dakotas was also much below normal, with the result that conditions at flowering time were not favorable for infection. The following statements from the United States Weather Bureau (Climatological Data 9&7: June & July, 1922) give an idea of the weather conditions in the spring wheat area:

Illinois, June: "June was moderately warm and very dry."

Iowa, June: "June was considerably warmer than normal and unusually dry."

Nebraska, June: "The weather conditions for June 1922 as shown by the monthly state averages, were warm and dry with an excess of sunshine."

Minnesota, July: "The special features of the month's weather were the unusual coolness and drought over much the larger portion of the state."

North Dakota, July: "The mean temperature for the state was 65.6° or 1.9° below normal. The average precipitation for the state was 2.43 inches or 0.18 inches below the normal."

South Dakota, July: "The average temperature during July was considerably below normal. The average precipitation for the state was considerably in excess of normal. Over most of the northeastern quarter, however, there was a decided deficiency, and in the extreme northern counties of the northwestern quarter the deficiency was considerable. At a few southeastern stations there was a deficiency."

The accompanying map (Fig. 26) shows the distribution of the rainfall in the spring wheat states for July, and also indicates the time of flowering of wheat in various parts of the area. This map, together with thepreceding statements regarding the weather conditions, suggests an explanation for the scarcity of scab in spring wheat during the year.

Recent literature

Dickson, James G. The influence of soil temperature and moisture on the development of seedling blight of wheat and corn caused by Gibberella saubinetii (Mont.) Sacc. (Abstract) Phytopath. 13: 50. Jan. 1923.

Eckerson, S. H. and James G. Dickson. The influence of soil temperature and moisture on the chemical composition of wheat and corn and their predisposition to seedling blight. (Abstract) Phytopath. 13: 50. Jan. 1923.

Henry, A. W. The pathogenicity of Fusarium moniliforme Sheldon on cereals. (Abstract) Phytopath. 13: 52. Jan. 1923.

Hopkins, E. F. Hydrogen-ion concentration in its relation to wheat scab. Amer. Jour. Bot. 9: 159-179. 1922.

MacInnes, Jean. The growth of the wheat scab organism in its relation to hydrogen-ion concentration. Phytopath. 12: 290-294. June 1922.

Wineland, Grace O. The production in culture of the ascigerous stage of Fusarium moniliforme. (Abstract) Phytopath. 13: 51. Jan. 1923.

Take-all caused by Ophiobolus cariceti (Berk. & Br.) Sacc.

In a paper by Fitzpatrick, Thomas and Kirby (1), published during 1922, the authors conclude that the Ophiobolus causing take-all of wheat in New York is the same Ophiobolus that occurs on wheat in England, France, Italy, and Japan, and that the Australian fungus is undoubtedly also the same. After comparing descriptions and material from a considerable number of sources they conclude that the correct name for the fungus is Ophiobolus cariceti (Berk. & Br.) Sacc.

During 1922 the disease was found occurring again in New York over even a somewhat larger territory than in 1921. However, although it was found in a higher percentage of fields, the disease was not so severe as during the previous year and the loss was not so great, being estimated at only about 1%. It was further esti-

mated that take-all occurred in about 64% of the wheat fields of New York state, most of which are in western New York where the disease is most prevalent. Kirby reports that Forward, Dawson, and Red Wave showed the greatest resistance of the varieties observed. The following are comments of the New York collaborators concerning the 1922 situation:

"The killing during this wet year was less than last year but the diseased plants were not as badly dwarfed and many infected plants showed almost no symptoms. In one or two wheat fields O. cariceti was found on nearly every plant but the number of dead plants was very low. It was observed that most of the plants had one or two healthy culms with normal heads but that the other culms were dwarfed and dead and were infected with O. cariceti.

County	Total no. fields surveyed	No. of fields with take-all	Average percent killed by take-all
Cayuga	59	57	1.3
Erie	1	1	.2
Genesee	38	11	t
Monroe	1	1	t
Orleans	7	1	t
Seneca	3	3	4.3
Tompkins	7	3	t
Wayne	8	8	1
Total	124	85	True Av. .8

(Kirby)"

"Last year Kirby and Thomas were of the opinion that manure containing contaminated straw was largely responsible for the persistence of the disease in wheat lands, but now after making a more careful examination of affected areas we are of the opinion that quack (Agropyron repens) which is somewhat resistant to the disease harbors the parasite from one wheat season until the next. We were able to find affected quack in nearly all of the take-all areas." (Barrus, July 7).

Reports of the occurrence of take-all in the field have also been received from the other three states reporting the disease last year. In Indiana a very slight amount was found on one farm in Knox County by H. S. Jackson. In Arkansas it was found again, in one field only, near Fayetteville where it caused a severe root rot and was affecting about 75% of the plants in the field. In Oregon, Barss reports that it was present in the Willamette Valley but was so scarce this year as to escape notice. The greatest damage found was 1% in one field near Hillsboro.

At the Wisconsin Experiment Station, H. H. McKinney conducted some experiments on the relation of soil temperatures to infection. Regarding the work, he reports as follows: (Cereal Courier 14: 23-25. Feb. 28, 1922)

"With the assistance of Mr. R. J. Davis, graduate student in

plant pathology, a preliminary soil-temperature experiment with Ophiobolus graminis has been carried on in the 'Wisconsin tanks.' Soil was inoculated with pure culture of the organism grown from a single ascospore isolated from a diseased wheat plant collected near Corvallis, Oregon. This experiment shows that at favorable soil temperatures, the parasite produces a severe seedling blight and often kills the plant within 14 days after sowing. The greatest injury occurred in soil held at temperatures near 22° and 24°C. The characteristic blackening of the base of the seedling and the 'plate' of the mycelium are strikingly evident. Badly infected seedlings turn yellow just below the tip of the leaves and gradually the whole plant turns yellow and then a bronze color. Severe root rotting also takes place at favorable temperatures.

"The seedling blight symptoms produced by Ophiobolus graminis are strikingly different from those produced by Helminthosporium sativum and Gibberella saubinetii as well as from the first symptoms of the false take-all. (rosette)."

References

(Cited):

(1) Fitzpatrick, H. M., H. E. Thomas, and R. S. Kirby. The Ophiobolus causing take-all of wheat. Mycologia 14: 30-37. 1922.

(2) Kirby, R. S. The take-all disease of cereals and grasses. Phytopath. 12: 66-88. Feb. 1922.

(Not cited):

Kirby, R. S. Heterothallism in Ophiobolus cariceti. (Abstract) Phytopath. 13: 35. Jan. 1923.

Rosette, cause undetermined

In the field, this disease was reported only from Indiana and Illinois, where it has been known to occur for several years. It was found on one additional farm in Laporte County, Indiana, by J. B. Kendrick, and in Illinois it was found scattered in a number of places on Red Cross wheat.

Very important progress on the study of the cause of this disease has been made during the past year by McKinney, Eckerson and Webb (1). They find intracellular bodies associated with the diseased tissues and report that in some stages the rosette disease strongly resembles mosaic. (See also report by Peltier on wheat mosaic, page 215).

Recent literature

(Cited):

(1) McKinney, H. H., Sophia H. Eckerson, and R. W. Webb. Intracellular bodies associated with the rosette disease of wheat. (Abstract) Phyropath. 13: Jan. 1923.

(Not cited):

McKinney, H. H., and Larrimer, W. H. Symptoms of wheat rosette compared with those produced by certain insects. U. S. Depart. Agr. Bul. 1137: 1-8. Pl. 1-4. March 1923.

WHEAT - Rosette

McKinney, H. H. Investigations of the rosette disease of wheat and its control. Jour. Agr. Res. 23: 771-800. Mar. 1922.

Stevens, F. L. The Helminthosporium foot-rot of wheat, with observations on the morphology of Helminthosporium and on the occurrence of saltation in the genus. Ill. Dept. Reg. Educ. Div. Nat. Hist. Survey Bul. 14: 77-186. 1-23. June 1922.

Helminthosporium blight caused by Helminthosporium sativum P. K. & B. (See also black point, page 214)

This fungus was the cause of seedling blight, leaf spot, and head blight in a number of states, particularly those in the spring wheat section. In Wisconsin Vaughan reports it as causing a trace of damage as a seedling blight and leaf spot all over the state on spring wheat. In Minnesota the disease was also reported as present throughout the state and causing considerable injury in some areas. It occurred in about the same amounts as usual there and took the form of leaf and head injury. In North Dakota, Weniger reports it as about as prevalent as usual and not very important as a seedling blight, but causing considerable damage as a head and kernel disease. One half percent reduction in yield for the state is estimated and some fields were found with 50% of the heads affected. The statement is made that this is a disease of durum wheat particularly, and more severe on red durums than on amber. It is confined to the Red River Valley conditions of heavier rainfall and soils. From Kansas and Idaho, this disease is reported as causing slight damage as a seedling blight, and from Saskatchewan the fungus was reported as common on stems and heads of durum wheat.

Recent literature - See rosette above.

Other foot and root rots

Aside from the take-all, rosette, and Helminthosporium blight, other foot and root rots have been reported during the year. Important progress has been made in the investigation of the disease that occurs in Kansas where it was reported from the six following counties during 1922: Riley, Jefferson, Dickinson, Sedgwick, Rice, and McPherson. An extensive co-operative project between the Kansas Experiment Station and the Office of Cereal Investigations is established at Abilene, Kansas, where crop rotations, soil fertilizers, soil sterilization, and varieties are being studied. Wojnowicia graminis (McAlp.) Sacc. & D. Sacc. has been found associated with this Kansas disease and the same fungus has also been collected during the past year in New York, where Kirby reports it on Dawson and No. 6 Junior, and in Oregon where Barss reports its occurrence in Union County.

Sclerotium rhizoides Auersw. was reported from Fremont County, Idaho, killing plants during the winter and early spring. The damage ranged from 1 to 50% loss in infested fields. Regarding it, Hungerford reported as follows:

> "Some time ago, I received specimens from the same county where the Helminthosporium root rot of wheat occurred last year, of a Sclerotium disease of wheat. I sent some to Dr. Humphrey and to Mrs. Patterson. A few days ago, I received a letter from Miss Charles stating that the disease was probably Sclerotium rhizoides. It appears that this disease has never been seen but once before

in the United States. A small specimen was sent in from Bozeman, Montana, some time ago."

From Oklahoma the disease known as white head was reported by Stratton as not being so conspicuous as last year. However, the disease is rated as one of considerable importance in that state.

From New York, Leptosphaeria was reported as being collected on one specimen, June 29.

From Utah, B. L. Richards writes the following concerning a serious root rot in Morgan County, November 21, 1922:

"We discovered a very serious root-rot of wheat in Morgan County, Utah this year. Two fields were so completely destroyed that they were plowed and seeded to another crop. Several other fields were seriously damaged. The only organisms which we are able to isolate are Rhizoctonia and Helminthosporium. The Helminthosporium has proven to be pathogenic in our pot cultures. Whether or not it is the real cause of the trouble we are unable to say at the present time. The disease is very destructive, killing many of the plants outright in the seedling stage and further continues to do damage to those which escape death at this period. The number of stems per stool average not more than two, while the normal plants gave an average, in the fields investigated, of 8 1/2. We are very much in hopes that we can survey this situation very carefully next year and further continue experimental work on the problem of determining what the cause of the disease really is."

From Tennessee, C. D. Sherbakoff reported the occurrence of a foot rot occurring in spots where on careful examination the plants were found to be infected at the base with a dark gray decay. The spots were not large or numerous. Studies of the cause of the decay are in progress.

From Kentucky, Valleau reports an early death in the spring of numerous small plants shortly after the stems begin to grow. The disease is common, especially in fields of low fertility and probably was not so prevalent as during 1921 because the season was much earlier. The yield is reduced by a killing of some of the plants and by failure of others to head.

Undetermined root rots were also reported from Minnesota and Idaho.

Reference

McKinney, H. H. and A. G. Johnson. Wojnowicia graminis (McAlp.) Sacc. and D. Sacc. on wheat in the United States. Phytopath. 11: 505-506. Dec. 1921.

Nematode disease caused by Tylenchus tritici (Stein.) Bast.

Definite records of the occurrence of wheat nematode in 1922 have been received from the first three of the four following states, in which the disease is known to occur: Virginia, West Virginia, North Carolina, and Georgia.

In Virginia more complaints were received than for several years, according to Fromme, and a loss of 0.5% is estimated for the state.

The most important new find in connection with this disease was the discovery of it in Haywood County, North Carolina. This county is in the west central

part of the state and is about midway between the infestation in Wilkes County, North Carolina, and Jackson County, Georgia. Specimens were received from Clyde, Haywood County, North Carolina, by A. C. Martin of the College of Agriculture at Raleigh on September 27 and submitted by him to the Plant Disease Survey where they were received October 1. The sample submitted contained 16% nematode galls, which is a high percentage for this disease.

Black chaff caused by Bacterium translucens undulosum S. J. & R.

The distribution of black chaff to date according to Plant Disease Survey reports is indicated on the accompanying map.

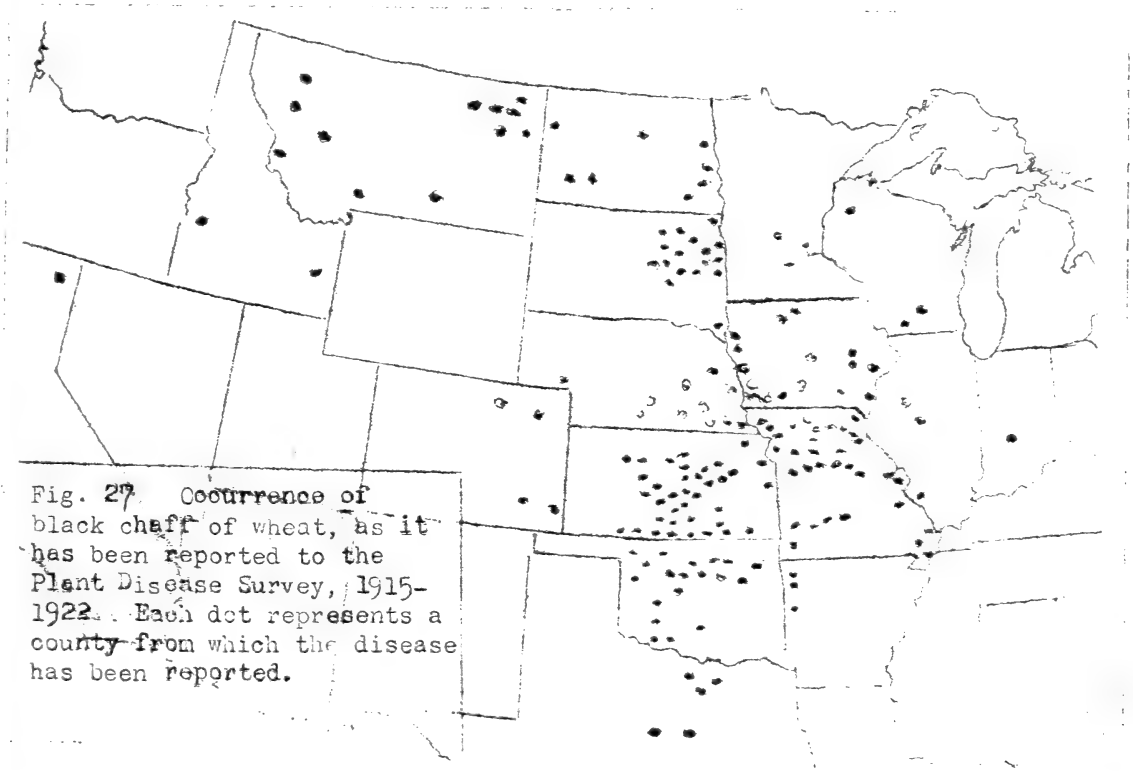


Fig. 27. Occurrence of black chaff of wheat, as it has been reported to the Plant Disease Survey, 1915-1922. Each dot represents a county from which the disease has been reported.

In 1922 black chaff was reported from Oklahoma, northwestern Arkansas, Wisconsin, Iowa, North Dakota (Cass and Pierce Counties infested, although others might have been and not reported - Weniger), eastern South Dakota (no data on distribution west of (Missouri) River - Evans), and southern Kansas.

The disease was widespread in Oklahoma, extending southwestward from the north-central part, where it was worst, according to Stratton, and causing severe losses in some fields. Stratton believes that the wet spring may have been responsible for the large amount of black chaff in the state. Of interest in this connection is Melchers' statement (July 15) that black chaff was found in southern Kansas where most of the rainfall of the state occurred.

Dates when the disease was first recorded are: June 3, Walters, Oklahoma; June, Fayetteville, Arkansas, and Brookings, South Dakota; July 16, Rugby, North Dakota.

WHEAT - Black chaff

Varieties reported as affected by black chaff are Kanred in Wisconsin, and Marquis, Preston, and Kota in North Dakota.

Table 70. Losses from and relative importance of black chaff of wheat, as reported by collaborators, 1922.

State	Importance 1922	Amount compared with 1921	Amount compared with Average year	Percentage loss
Oklahoma	Very important	More	More	2
Arkansas	None	Same	Same	0
Wisconsin	Minor	---	---	0
Iowa	Very little found	---	---	0
North Dakota	More found than in any previous year	More	More	Trace
South Dakota	Little	Same	Same	0
Kansas	---	Somewhat more	Trace	0

Anthracnose caused by Colletotrichum cereale Manns

Anthracnose was reported from New York, Pennsylvania, Delaware, Maryland, Virginia, Kentucky, Louisiana, Arkansas, Ohio, Indiana, Wisconsin, and Iowa. In Ohio it was much more prevalent than during 1921, and was the most destructive disease of wheat, according to R. C. Thomas, who said that while the disease occurred throughout the state it was more severe in the southern and western portions and in fields where wheat followed wheat. The total loss due to it was placed at fifteen or twenty percent. The injury described as due to anthracnose in Ohio is similar to the so-called "broken straw" reported from Kentucky and to similar diseases of unknown cause found in other states (see "broken straw" page). Other states reporting more of the disease than usual were New York, where the loss was estimated at 1%, and Pennsylvania. A loss of one-half percent was reported from Virginia, where the disease was said to be more common in the southeastern part. In other states where it occurred anthracnose was of little or no importance. The disease does not occur in Connecticut or Washington, according to collaborators.

Recent literature

Anthracnose disease ..... Ohio Agr. Exp. Sta. unnumb. leaflet. July 11, 1922.
Pl. Dis. Bul. 6: 27, 49. 1922.

Diseases caused by Septoria spp.

George F. Weber, in his recent paper on Septoria diseases of wheat (1) says:

"On wheat there are two diseases caused by different species of Septoria, namely, S. nodorum Berk. and S. tritici Desm. The one, caused by S. nodorum, attacks the glumes most commonly, pro-

ducing brown blotches on them, hence it has been called 'Glume Blotch.' ..... This disease may also attack the rachis, culms and leaves. The other disease, caused by S. tritici, attacks the leaves only, producing conspicuous light colored lesions in which the dark colored pycnidia are prominent and produce a speckled appearance. On account of this outstanding characteristic the name 'Speckled Leaf Blotch' is here suggested for this disease."

Glume blotch caused by Septoria nodorum Berk.

According to Weber, the glume blotch of wheat is widely distributed in the wheat-growing sections of the United States, but has been reported as most prevalent from the South and from the east-central states. Ordinarily the damage due to it is probably small, but it is sometimes reported as causing severe local losses.

When retained in pycnidia, pycnospores remain viable over winter in the vicinity of Madison, Wisconsin. The leaves may be infected at any time during spring, summer, or fall, while on the heads infection probably takes place about the time they appear out of the sheath.

In 1922 collaborators reported the glume blotch from Connecticut, New York, Pennsylvania, Delaware, Maryland, West Virginia, Virginia, Kentucky, Tennessee, Alabama, Arkansas, Wisconsin, Kansas; and in Canada it was reported from New Brunswick, (G. C. Cunningham) Saskatchewan, (W. P. Fraser) and Alberta, (G. E. Delong). The importance of the disease in the various states is indicated in the following table.

Table 71. Relative prevalence and importance of glume blotch of wheat, as reported by collaborators, 1922.

State	Prevalence and importance 1922	Amount compared with 1921	Amount compared with Average year	Amount of loss or damage
New York	General, moderate	Much more	--	.5-1%
Delaware	General, not important	Less	Same	---
Maryland	Most on Coastal Plain	More	More	.5%
Virginia	Especially in south	--	--	.5%, perhaps more
West Virginia	Slight importance	Same	Same	Apparently very slight
Kentucky	General	Much more	Much more	1% or less
Alabama	Slight, general	--	--	1-%
Arkansas	Slight	Same	Same	?
Wisconsin	--	Less	--	--
Alberta	--	--	--	Trace
New Brunswick	Very important, general; one of the chief causes of poor crops			
Saskatchewan	Not much observed, southern			

Regarding the loss of one-half percent reported from Virginia, Fromme says:

"The damage may be considerably in excess of the estimate, but there is little definite information in regard to injury from this disease."

WHEAT - Glume blotch

Maryland and Kentucky both report a wet season as very favorable to the disease, while in Wisconsin the weather was too dry during the heading stage of wheat to permit the development of the usual amount.

According to the results of inoculation experiments conducted by Weber, Poa pratensis, rye, and all species of wheat may be attacked by this disease. In the case of rye, however, only the leaves are affected, while with both wheat and Poa pratensis all parts of the plant above ground are susceptible. Triticum spelta, T. monococcum, and T. dicoccum were less susceptible than the other species inoculated, - T. durum, T. aestivum, T. compactum, T. turgidum, and T. polonicum. No especial difference in the susceptibility of the several varieties of T. aestivum was noted. The relative susceptibility of a number of varieties of wheat to this disease as observed at the Kentucky Agricultural Experiment Station and reported by Valleau is indicated in table 72.

Table 72. Susceptibility of wheat varieties to Septoria glume blotch at the Kentucky Agricultural Experiment Station, July 1, 1922.

Severity of Infection	Variety	Severity of infection	Variety
0	Alabama, C. I. 5785	0	Malakoff, C. I. 4898
0	Beloglina P 758 C. I. 1544	0	Mammoth Red 52, C. I. 5587
+++	Big Harvest Fultz - Purdue	++	Mediterranean, C. I. 3332
+++	Diamond C. I. 5710	++	Mediterranean, C. I. 5614
0	Dietz Longberry, C. I. 5570	++	Mediterranean, C. I. 5834
0	Early Red Chief, C. I. 3582	++	Michigan Amber, Purdue
++	Eclipse, C. I. 5674	+	Michikoff, Purdue
0	Economy, C. I. 3397	+++	Missing Link, C. I. 4866
0	Egyptian, C. I. 3049	++++	Nixon, C. I. 4867, Row 864
++	Farmer's Trust, C. I. 3346	++	Pennsylvania 44
0	Fulcaster, C. I. 3407	++++	Poole, C. I. 3366
0	Fultz, C. I. 4809	++++	Red Cross Row 33
0	Fultz, Row 226	+	Red Hussar, C. I. 4843
0	Fultzo-Mediterranean, C. I. 5353	++	Red Rock, Row 1115
0	Gluten B 86, C. I. 3427	0	Red Wonder, C. I. 5817
0	Golden Wave, Row 85	+	Sibley New Golden, C. I. 3520
0	Harvest Queen, C. I. 5314	0	Squarehead Master, C. I. 3283
0	Hickman, C. I. 5313	0	Stoner (Miracle), C. I. 5665
0	Hybrid 10c 5-2-4 Purdue	0	Stoner, C. I. 5777
++	Ill. Chief, Purdue	+	Trumbull, C. I. 5657
+	Imperial Amber, C. I. 4860	+	Turkey Minn. 1549
+++	Jolly Farmer, C. I. 5858	0	Turkish Amber, C. I. 5829
+	Kanred P-762, Kan. 2401	0	Valley, C. I. 3376
0	Lancaster-Fulcaster, C. I. 3455	0	P-1066 Kan. 2415
0	Lebanon, C. I. 3456	0	

++++ Indicates severe infection. 0 Indicates very little or no infection.

New York: Velvet-chaffed varieties seem to have heavier infection than the smooth-chaffed. (Chupp)

Maryland: Fulta is very susceptible (Temple and Jehle)

New Brunswick: Dawson's Golden Chaff, a fall variety, at least shows resistance, if not immunity. (G. C. Cunningham in Third Ann. Rept. of Canadian Plant Disease Survey).

Speckled leaf blotch caused by Septoria tritici Desm.

As is the case with the glume blotch, the speckled leaf blotch is also widely distributed in the United States, according to Weber. It has been reported from almost every wheat-growing state. The loss due to this disease is very difficult to determine. It seems to be greatest on seedlings in the fall and on tillers in the early spring. Under favorable conditions the disease may cause serious damage, and even death of plants. The pycnospores remain viable throughout the winter when retained in pycnidia, and the fungus overwinters in this stage. Wheat plants have become infected during every month except January and February in the vicinity of Madison, but the amount of new infections was less in late fall and early spring than during late spring, summer, and early fall. Volunteer seedlings are very important in the spread of the disease, since they serve to carry it over from harvest until the time when winter wheat has germinated. Early fall plantings are injured less than late sowings and the fungus attacks rapidly growing plants less easily than those growing more slowly. Septoria tritici attacks Triticum spp., rye, and Poa pratensis.

In 1922 collaborators reported the disease from New York, Delaware, Maryland, West Virginia, Kentucky, Arkansas, Indiana, Wisconsin, Kansas, Idaho, and California. Kansas reported that it was much more prevalent than usual. In Kansas, according to Melchers, it was "by far the most common ever noticed." The greatest loss (1/2 to 1%) was reported from New York. In other states it did not exceed a trace, and Kentucky and Arkansas reported that the disease caused no loss. In Arkansas the disease is said to appear only early in the spring, and afterwards to disappear. In Indiana, according to Kendrick, it is serious early in the spring.

Literature (Cited):

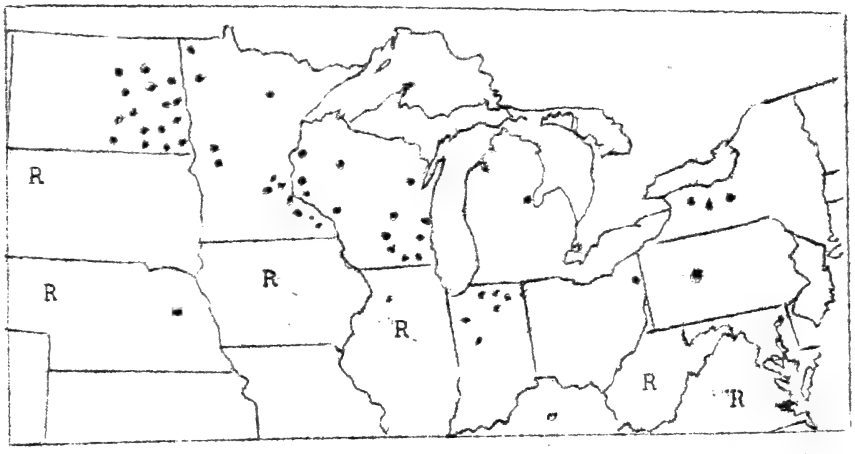
(1) Weber, George F. Septoria diseases of cereals II. Septoria diseases of wheat. Phytopath. 12: 537-585. Dec. 1922.

Ergot caused by Claviceps purpurea (Fr.) Tul.

The accompanying map (Fig. 28) gives the distribution of ergot on wheat as it has been reported to the Survey up to the present time. It will be noted that the map records occurrence only, severity and importance not being indicated. The disease has been reported most frequently from North Dakota and Minnesota.

In 1922 ergot on wheat was reported from New York, West Virginia, Wisconsin, Minnesota, Iowa, and North Dakota. The disease was of little importance apparently, only traces of it occurring even in North Dakota, where it was so conspicuous in 1921. Miss Weniger reports two factors to which this reduction in prevalence may be due: first, there was probably too little moisture for the germination of the sclerotia (sclerotia overwintered at Fargo failed to germinate); and second,

many farmers in the northeastern counties, where the disease was most abundant in 1921, floated the ergot bodies out of their seed wheat.



R= reported but locality not given

Reports received from Arizona (Maricopa and Coconino Counties) and Utah also.

Fig. 28. Distribution of ergot on wheat as it has been reported to the Plant Disease Survey, 1908-1922. Each dot indicates a county from which the disease has been reported.

In Canada, according to the Dominion Plant Disease Survey, ergot was found occasionally in southern Saskatchewan on durum wheat, in Manitoba, and New Brunswick, but was in no case important.

According to the following statements made by R. O. Cromwell, ergot in wheat is of more importance than would be indicated by its effect on the yield.

> "I was told by a local miller, who is somewhat of a practical man, that out of 100 cars offered to them at one time, only one was acceptable; the rest were rejected largely because of the presence of ergot, which they could not separate from the grain. This, of course, is nothing like representative of the crop as a whole. Any durum wheat rejected because of ergot would be sent for export. I understand that in the last two or three years ergot has affected somewhat the demand from importers for our durum wheat." (Dec. 1, 1922)
>
> "These cars came on the market early in the movement of the spring wheat crop and for the last month or so there has been much less trouble from this source. There is much less ergot than in 1921, but the territory involved is perhaps not a great deal smaller. Infection has occurred farther west than ever recorded by the trade.
>
> "Only small traces usually make this grain undesirable to local millers who are to make semolina. This product is rather coarse and the small pieces of ergot show up very plainly and it is impossible to remove them from the wheat because of equal size and specific gravity with the kernels.
>
> "From the standpoint of actual loss to wheat, ergot was unimportant in 1922, but as a pathological problem it is probably almost as important." (Jan. 22, 1923)

Powdery mildew caused by Erysiphe graminis DC.

Powdery mildew on wheat was reported from New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Kentucky, Arkansas, Ohio, Indiana, Wisconsin, Minnesota, Iowa, Kansas, Idaho, Oregon, and California. In New York it caused a loss of 1%, according to Kirby. In Pennsylvania the amount of damage due to it was not known. In other states from which it was reported the disease was unimportant and the loss caused was negligible or none. In Maryland, Virginia, and Kansas the loss was estimated at a trace.

Vaughan reports that in Wisconsin the disease caused a blight on winter wheat in the fall. Little Club wheat is said by Hungerford to be very susceptible to powdery mildew in Idaho.

Black point caused by a number of fungi

In a recent paper by Henry (2), it is reported that black point of wheat was produced artificially by inoculation with Helminthosporium sativum, Helminthosporium sp., Brachysporium and Stemphylium, all of which were isolated from black pointed kernels. Weniger (3) and Evans (1) report Helminthosporium sativum as being associated with most of the black pointed kernels. The disease occurs particularly in the spring wheat area and is apparently most common on the durum varieties.

Literature (Cited):

(1) Evans, Nevada S. "Black point" of wheat. Phytopath. 11: 515. Dec. 1921.

(2) Henry, A. W. Some fungi causing black point of wheat. (Abstract) Phytopath. 13: 49. Jan. 1923.

(3) Weniger, Wanda. Pathological morphology of durum wheat grains affected with "black point." (Abstract) Phytopath. 13: 48-49. Jan. 1923.

Seedling blight caused by Fusarium sp.

Slight amounts of this disease were reported from New York, North Dakota and from Manitoba (See also scab, page)

Broken straw

Statements from collaborators concerning a breaking over of wheat straw have been reported from Kentucky (Pl. Dis. Bul. 6: 27, July 15, 1922) and Montana (Pl. Dis. Bul. 6: 51, Aug. 1, 1922). In the former state as much as 6% damage is estimated on account of the sudden ripening and twisting and breaking of the stems at the top or second joint. Different varieties in the same field showed marked differences in susceptibility to this breaking over, according to Valleau. From the upper nodes of affected plants Fusarium, Helminthosporium, Alternaria and other fungi were isolated. It has been suggested that infection by leaf rust might have been responsible for at least a part of this injury.

In Montana the stems were reported as breaking over at points six or eight

inches below the heads. Dark colored lesions were found on the leaf sheaths and culms the characteristics of which suggest a bacterial cause, according to H. M. Jennison.

From Canada a somewhat similar disease called "crinkled joint" was reported in 1922, which was characterized by a kink or abrupt bend on the lower internodes of the stem. As the plant became old the stems broke at this point and the plant fell over. This was reported both from Alberta and Saskatchewan. (Canadian Plant Disease Survey report 1922)

Mosaic (Undet.)

From Nebraska, G. L. Peltier reports a mosaic of wheat. Plants showing the disease were found in a large number of both winter and spring wheat varieties at Lincoln, Nebraska. Preliminary inoculations in the greenhouse using the juice of infected plants gave positive results in some instances on wheat and corn. Aphids found feeding on mosaic wheat plants in the field were transferred to young corn plants in the greenhouse and a slight infection was produced on one plant. Seed from infected plants produced individuals showing no more mosaic than plants from healthy seed sown as a check. (See also rosette of wheat, page 205).

Other diseases

Basal glume rot caused by Bacterium atrofaciens McCulloch was first described in 1920 (McCulloch, Lucia. Basal glumerot of wheat. Jour. Agr. Res. 18: 543-552. Feb. 16, 1920). It was found by Miss McCulloch in collections from New York, Michigan, Kansas, Missouri, Minnesota, North Dakota, Oklahoma, and Alberta. It has never been reported to the Survey by collaborators. In 1922 the disease occurred in Saskatchewan, Manitoba, and Alberta, according to the Canadian Plant Disease Survey, but was not common or severe in any case.

Sooty mold caused by Hormodendrum cladosporioides Sacc. - California: "Considerable damage to wheat near the coast but less than last year." (Mackie).

Stripe, cause unknown - trace in Genesee County, New York (Kirby). Stripe has been reported from New York every year except 1920 since 1917, and according to J. G. Dickson, the disease has been common in Illinois and Wisconsin at least.

Vegetable proliferation of heads - Indiana and Oregon (Pl. Dis. Bul. 6: 87, Sept. 1; 100, Sept. 15, 1922).

RYE

Stem rust caused by Puccinia graminis Pers.

Rye was damaged only very slightly by stem rust in 1922. The disease was reported in the majority of the states east of the Mississippi River and from Minnesota, Iowa, the Dakotas, Nebraska, Kansas, Arkansas, Colorado and Utah, but none of these states rate the disease as important on rye. In fact, the only states estimating any particular damage from this disease are Ohio with 1%, and Illinois and Minnesota both with .5%.

Collaborators in North Dakota make the statement that Puccinia graminis has not been severe on rye for the last four or five years. No reports of damage

to rye are given in the Canadian survey report for 1922.

Recent literature:

Levine, M. N. and E. C. Stakman. Biologic specialization of Puccinia graminis secalis. (Abstract) Phytopath. 13: 35, Jan. 1923.

Leaf rust caused by Puccinia dispersa Eriks.

Summary by E. B. Mains

"The leaf rust of rye was about as widespread as the leaf rust of wheat, but apparently not as severe. It was found present fairly heavily in Georgia, South Carolina, Virginia, Tennessee, Kentucky, Indiana, Illinois, and Wisconsin, being especially noticeable in Georgia, South Carolina, Tennessee, and Kentucky. The loss is much more difficult to estimate than the leaf rust of wheat, but probably averages about 1-2%. That the aecial stage of this rust may occur naturally in this country is shown by our discovery (1) of it on Anchusa used as a border plant for flower gardens at Lafayette. In view of the widespread occurrence of the rust in this country without this stage, it is doubtful if it will prove to be of much importance.

"Considerable progress has been made in obtaining strains of rye resistant to leaf rust. Plants highly resistant to leaf rust have been found in all the varieties tested,-Star, Rosen, Mammoth Winter, Abruzzes, Petkus, Giant Winter, Virginia, Henry, Ivanov, St. John, Von Ruemker, Invincible and Mexican. The best of these have been grown to maturity and further selections and studies are being made."

Table 73. Estimated percentage loss from leaf rust of rye, according to collaborators, Plant Disease Survey, 1922.

Estimated percentage loss	States	Estimated percentage loss	States
2	Ohio, Indiana, Illinois	.5	Delaware, Alabama
1.5	Connecticut, New York, Virginia, South Carolina, Georgia	Trace	Pennsylvania, West Virginia, Mississippi, Wisconsin, Minnesota, Iowa, North Dakota, Kansas, Oklahoma, Colorado, California.

Literature cited:

(1) Mains, E. B. and H. S. Jackson. Aecial stages of the leaf rust of barley, Puccinia simplex, and of rye, P. dispersa, in the United States. (Abstract) Phytopath. 13: 49. Jan. 1923.

RYE - Scab, Anthracnose, Powdery mildew, Stem smut

Scab caused by Gibberella saubinetii (Mont.) Sacc.

Very slight amounts of scab were reported on rye this year from New York, Delaware, Ohio and Wisconsin. Numerous collaborators in other states reported not having observed the disease on this host. The disease was of practically no economic importance.

Anthracnose caused by Colletotrichum cereale Manns

Anthracnose was reported from most of the states in the northeastern quarter of the country and from Oklahoma. Judging from the reports received, the disease was probably more serious than is usual. Ohio was apparently the center of the epidemic and in that state it is estimated that about one quarter of the crop was lost on account of this disease. It appeared in late June and by attacking the base of the culms, caused shriveled grain and fallen straw. It was generally distributed over the state but was worst in the western and southern portions. It was by far the worst disease of the crop in that state. Rosen rye suffered a heavy loss.

Other losses reported are as follows: New York, 1%; Virginia, 2%; Indiana, 4%; and Oklahoma, .5%. In Oklahoma the disease was reported as being important in the northern part of the state.

Powdery mildew caused by Erysiphe graminis DC.

Although powdery mildew was reported on rye only from Delaware, Maryland, West Virginia, Ohio, Indiana, Wisconsin, Minnesota, Iowa, and California, it was probably somewhat more prevalent on rye this year than usual. In Minnesota heavy infection was observed locally in the east central part of the state, it being first observed May 29.

Stem smut caused by Urocystis occulta (Wallr.) Rab.

A few occurrences of stem smut were reported during 1922, from Maryland, Virginia, West Virginia, Indiana, Illinois, Wisconsin, Iowa, and North Dakota. Apparently it was more common in Minnesota, as high as 1% loss being estimated for that state with some fields showing as much as 10% infection. From North Dakota collaborators report that the disease has never been severe in that state as far as records show and in 1921 it was reported from only one locality, on June 20.

Recent literature:

Müller, H. C. and E. Molz. Neue versuche zur bekämpfung des roggenstengelbrandes, Deut. Landw. Presse 49: 491. 1922.

Head smut caused by Ustilago sp.

Reports of collections of the head smut of rye were received from three states by the Plant Disease Survey during 1922. One infected head of volunteer rye was collected on May 20 at Ithaca, New York; and at the United States Depart-

ment of Agriculture Experiment Farm at Arlington, Virginia, H. B. Humphrey and V. F. Tapke, found a considerable number of specimens occurring naturally in some of the varietal test plots. In Madison County, Illinois, the men engaged in the wheat flag smut survey found a number of plants affected with loose smut in a number of different places during May and June.

An examination of past survey records shows that this disease has been collected in other years from the following states: New York, Virginia, Tennessee, Indiana, Illinois, Missouri, Oklahoma, Minnesota, and North Dakota.

Ergot caused by Claviceps purpurea (Fr.) Tul.

Ergot of rye was reported rather frequently from states where the crop is grown. As usual, volunteer rye was reported as especially affected. In none of these states were especially heavy losses sustained. Estimates of one half of one percent loss have been received from Ohio, Illinois, and North Dakota, and one percent loss was estimated as occurring in Minnesota. In that state slightly more of the disease was reported than usual, occurring in all fields to a greater or lesser extent. The earliest reported appearance in Minnesota was June 11, in Dakota County. In North Dakota less ergot occurred than during 1920 or 1921. Concerning this W. Weniger reports as follows:

> "With rye harvest over, and many fields already threshed, there has been little report of the occurrence of ergot. Last year there was heavy infection, but this year it is very slight. Locally, there was some ergot, and also evidence of blighting of kernels due to infection by Claviceps. The weather has apparently been unfavorable for germination of sclerotia at Fargo, since various lots of them, overwintered out of doors and also in doors, failed to germinate in the field.
>
> "Some spring rye was found heavily infected at Dickinson July 25th, but the winter rye beside it was almost free from infection. Volunteer rye was generally infected."

In a recent paper by W. W. Bonns (1) the commercial value of ergot in the manufacture of pharmaceutical preparations is brought out. It is stated that the annual import of ergot into the United States for the six years ending with 1919 ranged from 58 to 112 tons with a valuation ranging as high as $208,000. The statement is further made that, -

> "The great commercial sources of the sclerotia in the past have been Spain and Russia. During the recent war, American drug manufacturers experienced a great shortage of ergot, and as a result quotations rose by leaps and bounds. In the early part of 1914, high-grade Russian ergot could be bought for 43 cents a pound, duty paid. During the first part of 1920, quotations on this drug ranged between $5.00 and $6.00 a pound."

Recent literature:

(1) Bonns, W. W. A preliminary study of Claviceps purpurea in culture. Amer. Jour. Bot. 9: 339-353. July 1922.

Pammel, L. H. Ergotism. Vet. Med. 17: 89. 1922.

RYE - Miscellaneous diseases

Other diseases

Bunt caused by Tilletia tritici (Bjerk.) Wint. has been artificially produced in rye at the Washington Agricultural Experiment Station by Dr. E. F. Gaines.

Take-all caused by Ophiobolus cariceti (Berk. & Br.) Sacc. occurred in New York on rye growing in ground heavily infested with the organism, according to Kirby. The disease caused a slight stunting of the plants. It is not of economic importance on rye in New York. First observed June 28 at Auburn.

Leaf spot caused by Helminthosporium sativum P. K. & B. The Section of Plant Pathology of the University of Minnesota reports less of this disease than usual, only three observations having been made during the year. The disease, however, was probably general over the state.

Septoria secalis, Prill. & Delacr. - reported by J. G. Dickson as abundant early in the season, but the cause of little damage in Wisconsin. Weber (1) has reported this as occurring in the past in West Virginia, Virginia, Illinois, and Wisconsin.

Leaf blotch caused by Rhynchosporium secalis (Heins.) Davis - scattered infections early in season reported by J. G. Jackson in Wisconsin.

Bacterial blight caused by Bacterium translucens fairly abundant in Wisconsin early in the season, according to J. G. Dickson.

Bacterial leaf spot was noted on rye in plots at Moscow, Idaho, according to C. W. Hungerford.

Failure of rye. In Kentucky each year numerous fields of rye come to the heading stage and fail to fill seed. Often crop is entire loss. Seems to be root trouble, but not certain. All small grain affected in same way to some extent but not so marked as with rye. (Valleau)

Literature cited:

(1) Weber, George F. Septoria diseases of cereals III. Septoria leaf blotch of rye. Phytopath. 13: 1-2. Jan. 1923.

BARLEY

Covered smut caused by Ustilago hordei (Pers.) K. & S.

Covered smut occurred during 1922 in about normal amounts, judging from collaborators' reports. A considerable number of states rated the disease as relatively unimportant, but in some of them, especially Kentucky, Texas, Oklahoma and Kansas the disease was a considerable factor in reducing yield.

The following losses were reported:

3% . . . Connecticut, Georgia, Texas, Oklahoma, Kansas
2 . . . Vermont, Iowa
1 . . . Minnesota, North Dakota, California
.5 . . Alabama, Wisconsin, Idaho

A number of other states reported less than 1% loss.

In California, W. W. Mackie reported the disease as very scarce over the entire state, but occurring most plentifully where optimum moisture conditions prevailed. Wet weather and wet soils are apparently favorable for covered smut, according to Mackie.

BARLEY - Covered smut, Loose smut

Seed treatment experiments with the use of organic mercury compounds have been conducted during the past few years by W. H. Tisdale and J. W. Taylor (1) of the Office of Cereal Investigations. A considerable number of the materials tried caused improved germination of oats and barley in the greenhouse and in the field, increased field stands and controlled barley smuts excellently. Seed treatment tests by Mackie in California indicate that:

> "The bluestone lime method is best for dry sown barley in the interior. Formaldehyde may be used with late sown barley or in the Coastal regions. Copper carbonate dust is not as fully effective as the fungicide just mentioned."

More covered smut was observed in hooded barley in Wisconsin than in other types of this cereal, according to R. E. Vaughan. However, hooded barley is not extensively grown in the state.

Literature cited:

(1) Tisdale, W. H. and J. W. Taylor. Organic mercury seed disinfectants. Phytopath. 13: 38. Jan. 1923.

Loose smut caused by Ustilago nuda (Jens.) K. & S.

The only states recording loose smut as of much importance during 1922 are New York, Virginia, Kentucky, Indiana, Texas, Oklahoma, Iowa, and Kansas. Judging from reports it was prevalent in about the same amounts as usual. On account of the similarity of this smut to the covered smut, it is possible that the two are sometimes confused in plant disease survey reports.

Losses reported during 1922 are as follows:

5%	Virginia
4	Oklahoma
3	Kentucky, Texas, Kansas
2	New York, Indiana, Iowa
1	Maryland, North Dakota
.5	Illinois, Wisconsin, Minnesota
Trace	Vermont, Massachusetts, Tennessee, Colorado, Utah

Successful results were obtained with the hot water treatment on a number of farms in Kentucky during the year. The practice of treating barley seed with hot water is increasing in that state, according to Valleau.

Recent literature:

Foëx, E. Un charbon de l'orge. Journ. Agr. Prat. 149 (n. s. 38): 181. Aug. 26, 1922.

Stem rust caused by Puccinia graminis Pers.

In 1922 the stem rust of barley was reported of importance only in the north-central states. It occurred in widely scattered localities from Vermont to California and from Alabama to Canada, but apparently it was of economic importance only in the states shown on the accompanying map (fig. 29). In a con-

siderable number of these states it was noted that the disease was especially severe on barley near barberries. From the data at hand it would appear that wheat suffered the greatest loss from stem rust, with barley, oats, and rye following in the order named.

From the middle western provinces of Canada reports indicate that the rust was common on barley but did not cause much damage. On the other hand, on Prince Edward Island the disease was not only common, but was the cause of severe loss in several cases. (Canadian Plant Disease Survey report 1922).

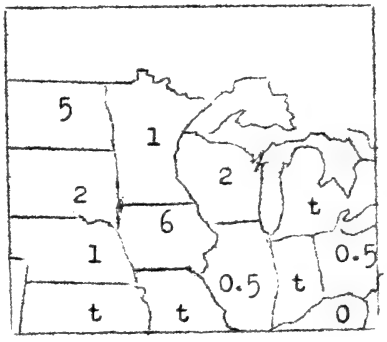


Fig. 29. Estimated percentage of loss from stem rust of barley, 1922.

Leaf rust caused by Puccinia simplex (Koern.) Erikss. & Henn.

Leaf rust of barley was reported to the Survey in 1922 from Connecticut, New York, Delaware, Maryland, Virginia, Kentucky, Georgia, Alabama, Louisiana, Indiana, Wisconsin, Iowa, and California. According to G. R. Bisby, the rust was collected for the first time in Manitoba.

Summary by E. B. Mains:

"The leaf rust of barley is apparently only severe locally. It was found attacking barley fairly heavily at Experiment, Georgia; Blacksburg, Virginia; Lexington, Kentucky; and to somewhat less extent at Washington, D. C. It probably caused a moderate reduction in yield at these places, but the average for the country is undoubtedly very slight.

"We have this spring successfully repeated Tranzschel's work carried out in Russia in 1914, infecting Star-of-Bethlehem, Ornithogalum umbellatum, with the rust, producing the aecial stage (1) both in the greenhouse and in the field. This connection may be of importance in regions like southern Indiana, where Star-of-Bethlehem has escaped and become a serious weed, if winter barley should become widely grown. At least it should be called to the attention of pathologists as a dangerous neighbor in barley culture."

Literature cited:

(1) Mains, E. B. and H. S. Jackson. Aecial stages of the leaf rust of barley, Puccinia simplex, and of rye, P. dispersa, in the United States. (Abstract) Phytopath. 13: 49. Jan. 1923.

Stripe rust caused by Puccinia glumarum (Schm.) Erikss. & Henn.

(See wheat page 220).

Net blotch caused by Helminthosporium teres Sacc.

In 1922 net blotch was reported from New York, South Carolina, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Colorado, and California. According to the report of the Canadian Plant Disease Survey it also occurred in Alberta, Saskatchewan, and Manitoba. The more important of the state reports are as follows:

Wisconsin: Less than last year, developed abundantly late in season on volunteer plants. (Vaughan)

Minnesota: Found on University Farm early in June, and in McLeod County during the latter part of July. Difficult to say how much damage was caused by net blotch. (Sect. Plant Path.)

South Dakota: Same as last year, abundant in some fields, 1% reduction in yield for state. (Evans)

California: Noticeably less over the state this year, and as usual appearing in greater quantity on early and volunteer barley. (Mackie)

Dates of first appearance:

April 25, Clemson College S. C.
June 1, Ramsey County, Minn.
June 3, Racine Wis.
July, Ithaca, N. Y.
July, Brookings, S. D.
July, Fort Collins, Col.

Stripe caused by Helminthosporium gramineum Rab.

During 1922 state collaborators reported the following losses from stripe:

Trace, Vermont, New York, Delaware, Maryland, Virginia, Oklahoma, Colorado and Idaho.
0.5%, Wisconsin
.1%, North Dakota
2%, Indiana and Minnesota
3%, Tennessee
4%, Utah
5%, Iowa

In the majority of the states the disease was prevalent in about the same amounts as usual and was relatively unimportant. However, Iowa and Utah reported 5 and 4% loss, respectively, and from Ohio and Wisconsin more of the disease than usual was reported. From the latter state, R. E. Vaughan reports: "More than last year but not serious as in 1917 and 1918. 19% on Wisconsin Pedigreed #6 barley was found in several fields." The Canadian Plant Disease Survey reports the disease as common in Alberta, Manitoba, Saskatchewan and Prince Edward Island.

Dates of first appearance.

June 1, Ramsey County, Minn.
June 3, Racine, Wis.
June 28, Auburn, N. Y.
July 6, Ashland County, Ohio
July, Fort Collins, Col.

Reference cited:

Riehm, Eduard. Die streifenkrankheit der gerste. Flügbl. Biol. Reichanst. Land- u. Fortstw. 68. Sept. 1922.

BARLEY - Spot blotch, Scald, Root rots

Spot blotch caused by Helminthosporium sativum P. K. & B.

During 1922 spot blotch was reported from New York, Wisconsin, Minnesota, Iowa, Colorado, and California. In most cases it was of relatively slight importance but in New York it was estimated that it occurred in practically all of the fields in the state and probably reduced the yield about 3%. In Minnesota also the organism caused a spotting of the leaves and a foot and root rot occurring in all fields and probably reducing the state yield 2%. In that state injury through rotting of the roots and base of the plants appears to be considerably greater than that caused by the blotches on the leaves. From California no estimates of damage were received, but W. W. Mackie makes the statement that it was prevalent and about as usual, appearing at its maximum late in the season. R. E. Vaughan in Wisconsin reports more spot blotch on the very early plantings than on the later ones.

Scald caused by Rhynchosporium secalis (Heins.) Davis

Wisconsin, Iowa, Idaho, Oregon, and California report scald in 1922. In Wisconsin it was general early in the season but not severe and minor in importance for the state as a whole. In Idaho, Hungerford reported less of the disease than the average, but common throughout the state, although unimportant. In Oregon it was common but not reported as causing much loss. From California W. W. Mackie reports the following:

> "Scald attack was less severe this year but occurred in all fields over the State. As usual early sown barley suffered most. A number of barley hybrids bred for scald resistance have proved highly resistant to scald, combined with high yield, good quality of grain and resistance to lodging."

The disease was also reported by the Canadian Plant Disease Survey from Edmonton, Alberta, Canada, in 1921 and 1922. According to them these are the first reports of this disease in Canada (Canadian Dept. Agr., Div. Bot. Surv. Pres. Pl. Dis. Dom. Canada, 1922, 3rd Ann. Rept.).

Root rots probably caused by Fusarium sp.

The two following reports on barley root rots have been received:

Illinois: We have one report only of root rot of barley this season. It comes from Will County and is reported to be present in serious form in two fields only. The roots and culms have a pinkish color leading one to suspect Fusarium. (L. R. Tehon)

California: Common in nearly all fields but less injurious than last year. Attacks on wheat, barley and oats. (Mackie)

Miscellaneous diseases

Scab caused by Gibberella saubinetii (Mont.) Sacc. Scab attacking heads of barley was found in New York, Maryland, Ohio and Wisconsin. In no instance was it causing particular damage.

BARLEY - Miscellaneous diseases

Powdery mildew caused by Erysiphe graminis DC. New York, Delaware, and Kentucky report powdery mildew in barley. No particular damage was recorded. In Kentucky a case is reported where barley plants were heavily infected while in adjoining wheat the powdery mildew was practically absent.

Anthracnose caused by Colletotrichum cereale Manns reported from Wisconsin, Texas, and Louisiana.

Leaf blotch caused by Septoria passerinii Sacc. is reported by Weber (1) as having been found in other years in Wisconsin, Minnesota, and the Dakotas.

Ergot caused by Claviceps purpurea (Fr.) Tul. Minnesota and Idaho are the only states reporting infection of barley with ergot. In Minnesota light infections were found at the University Farm on ten different varieties, and in Idaho heavy infection occurred locally in Fremont County.

From Manitoba, G. R. Bisby reports that this disease was found at Winnipeg and reported as quite common at Morden.

A rusty spot of barley, cause undetermined, was reported by W. W. Mackie from California as follows:

> "Rusty spot of barley has been observed for four years. During 1922 it increased noticeably especially in the Sacramento Valley where fields near Woodland were practically ruined. The grain was reduced from malting to feed grade and the crop reduced to one-fourth."

Black spotting of leaves, cause unknown but distinct from spot blotch or net blotch, was fairly common in Idaho this year, according to C. W. Hungerford.

References:

(Cited):

(1) Weber, George F. Septoria leaf-blotch of barley. In Septoria diseases of cereals III. Phytopath. 13: 5-7. Jan. 1923.

(Not cited): Muller, H. Das gelbwerden der wintergerste. Deutsche Landw. Presse 49: 115-116. Feb. 25, 1922.

Zimmerman, Hans. Typhulapilzbefall der Wintergerste 1921. Nachrichtenbl. Deut. Pflanzenschutzd. 2: 41-42. June 1922.

OATS

Smuts caused by Ustilago avenae (Pers.) Jens. and U. Levis (K. & S.) Mag.

The two smuts continued to be the most destructive diseases of oats as usual. While some states reported less smut this year, others reported about the same as or slightly more than during 1921, so that for the United States as a whole there was probably less damage from oat smut than during 1921. The principal reasons for this may be found in a more general practice of seed treatment and in the weather conditions which, according to collaborators, were influential in cutting down the amount of smut in some cases.

The accompanying map gives collaborators' estimates of the percentage reduction in yield from the two smuts.

The maximum amount of smut found in any one field is of interest. Thus in Michigan from 25 to 35% by actual count was found in some untreated fields. In Wisconsin 30% was determined; in Virginia 25%; New York 25%; and in West Virginia 10%.

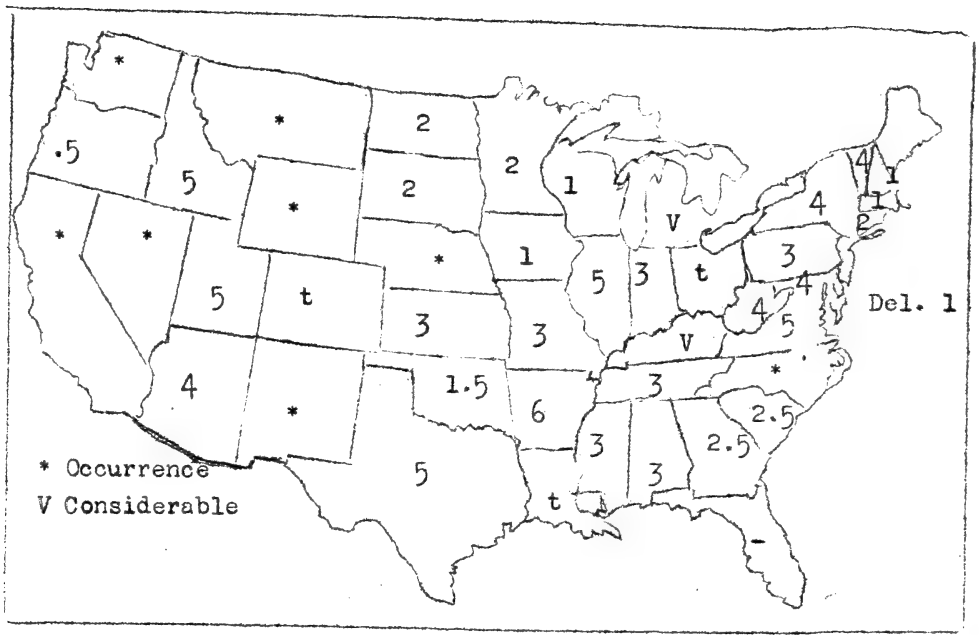


Fig. 30. Estimated percentage reduction in yield from oat smuts in 1922, according to collaborators. (For revised and final figures see crop losses from plant diseases in the United States in 1922. Pl. Dis. Bul. 30, 1923).

In parts of Ohio, Indiana, Illinois, Missouri, Nebraska, and Kansas the oats crop suffered considerably on account of weather conditions. Wet weather in the spring delayed planting in many cases, and dry weather prior to maturity caused further shrinkage. Collaborators in some of these states attribute variations in amount of smut to these conditions. The following reports are of special interest in this connection:

Ohio: Of less than average importance. A few fields were seen in northern Ohio in which the infestation was estimated at 5 to 8%. In most fields, however, the amount of smut was negligible. Increased interest in seed treatment is regarded as one factor in this condition. Owing to adverse weather conditions in early spring, difficulty was experienced in fitting the soil for oats and a large part of the planting was unusually late. It is suggested that the late planting was followed by favorable conditions for growth with the result that the period was shortened during which the seedlings were in the favorable stage for smut infection. (W. J. Young, Aug. 15).

Illinois: Present throughout the state, probably causing considerable loss. Early spring rains prevented planting until late, resulting in a poor crop in many places. Hence, the total loss from smuts this season should be less than usual. (L. R. Tehon, Aug. 15).

Wisconsin: More than usual, 1921 crop nearly a failure and purchased seed for sowing in 1922 brought considerable smut. (Vaughan, Aug. 15)

Success with organic mercury compounds as seed disinfectants for the control of oat smut has been obtained by the Office of Cereal investigations (1) These materials have not only controlled smuts on oats, but have increased the yields over those from untreated seed. The mercury compounds proved superior to copper carbonate or other dust treatments in the control of oat smut. Tests with these compounds are also being made in Kansas, according to L. E. Melchers.

Variation in susceptibility of varieties to oat smut were reported as follows:

Wisconsin: Pedigree No. 5 shows high degree of smut freedom when compared with other varieties and selections at the Spooner Branch Station. (Vaughan)

Minnesota: Sixty Day, White Tartar, Iowa 670, Iowa 103, Lincoln 505, the most susceptible varieties. (Section of Plant Pathology)

North Dakota: New Victory oats very severely attacked at Dickinson. (Weniger)

Kansas: Selections of Burt are showing marked resistance. (Melchers)

References (Cited):

(1) Tisdale, W. H. and J. W. Taylor. Organic mercury seed disinfectants. (Abstract) Phytopath. 13: 38. Jan. 1923.

(2) Zade, A. Experimentelle untersuchungen über die infektion des hafers durch dem haferflugbrand (Ustilago avenae Jens.) Fühl. Landw. Zeit. 71: 393-406. Nov. 1922.

Stem rust caused by Puccinia graminis Pers.

During 1922 slight amounts of stem rust of oats were reported from the eastern and southern states, but in none of these sections was the disease said to be the cause of more than a trace of damage. However, in the Dakotas, Minnesota, Wisconsin, Mighican and portions of Iowa, reports indicate that the disease caused damage, particularly to late planted oats. In Iowa and South Dakota, Melhus and Evans, respectively, report that the slight amount of damage this year was due to a late appearance of the rust.

The largest loss is reported from North Dakota. In this state as high as 5% reduction in yield is estimated by collaborators. In Minnesota infection was fairly general over the southern part of the state, but not heavy except in the vicinity of barberries. A loss of 2% is reported from Minnesota. In Wisconsin, late seeded oats were damaged but the majority of the oats were harvested before the rust became serious. R. E. Vaughan estimates an average loss of 1% for the state. According to R. T. Stanton (Cereal Courier 14: 230. Aug. 10, 1922) an epidemic of stem rust occurred on oats in southeastern Minnesota and northeastern Iowa. In local areas of northern Arizona and southern California, the disease was reported as doing damage.

Canadian plant disease survey reports show that stem rust on oats was severe in both western and eastern Canada last year. It was very severe on late

OATS - Crown rust

Oats in southern Saskatchewan, and probably lessened the yield to a considerable extent. The plant pathologists at Manitoba report it also severe on late oats in the southern part of that Province, while other records from Ontario, New Brunswick and Prince Edward Island report the disease as being of a serious nature, particularly late in the season.

Collaborators in Minnesota and North Dakota report White Russian oats as resistant. The variety Victory was reported as susceptible in Minnesota. Work on breeding oats resistant to stem rust is in progress at the Minnesota Agricultural Experiment Station (1).

Literature
(Cited):
(1) Griffee, Fred. Breeding oats resistant to the stem rust. Jour. Hered. 13: 187-190. 1922.
(Not cited):
Parker, J. H. A review of literature on the rusts of oats, with notes on their distribution in the United States. Proc. Kansas Acad. Sci. (51st-53d Ann. Meet.): 71-118. 1922.
Stakman, E. C., M. N. Levine and D. L. Bailey. Biologic specialization of Puccinia graminis avenae. (Abstract) Phytopath. 13: 35. Jan. 1923.

Crown rust caused by Puccinia coronata Cda

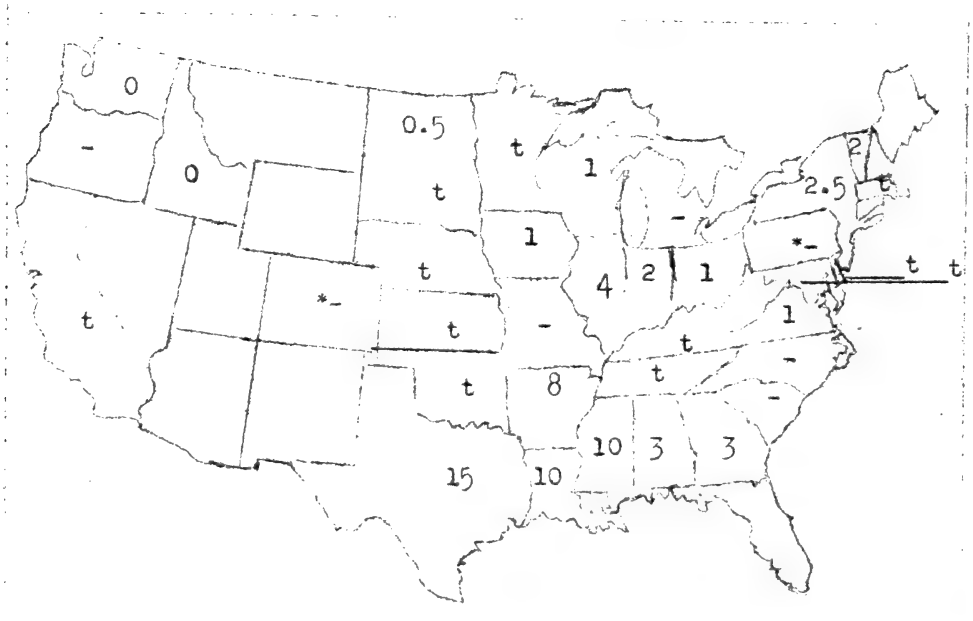


Fig. 31. Estimated percentages of loss due to crown rust of oats in the United States in 1922, according to collaborators.

Throughout the country as a whole more crown rust was reported during 1922 than in the preceding year, although in Louisiana, Arkansas, and Texas the losses

were not so great. The following states report more of the disease than during 1921: Connecticut, New York, Delaware, Georgia, Mississippi, Indiana, Illinois, and North Dakota. Only Louisiana, Texas, Ohio, Iowa, and Kansas report less than in 1921. As usual the greatest damage occurred in the South where winter oats are grown especially. A glance at the accompanying map (Fig. 31) will show the high percentage of loss in this section and also that considerable losses were sustained in a number of other states as well. Crown rust is second to the oat smuts in importance.

Table 74. Dates of earliest appearance of crown rust.

On Rhamnus		On oats	
Date	Place	Date	Place
May 8	Nebraska	January	Baton Rouge, Louisiana; Athens, Ga.
May 19	Minnesota	April 20	A. & M. College, Mississippi
May 25	North Dakota	May 3	Drainland, South Carolina
		May	Arkansas
		June 6	Jefferson County, Illinois
		June 15	Iowa; Wayne County, Ohio
		June 16	Rice County, Minnesota
		June 26	Auburn, New York
		June 30	Delaware and Fond du Lac, Wisconsin
		June	Brookings, South Dakota
		July	Fort Collins, Colorado

The following comments from collaborators as to reasons for greater or lesser amounts of rust and as to resistance in varieties, are of interest:

Louisiana: Very severe even on the local resistant varieties, non-resistant varieties were killed without heading. The actual loss in the state was not so great as a year ago because there was not so much seed shipped in for planting purposes. (Edgerton)
(Outside seed apparently less resistant than native.)

Arkansas: Late varieties more severely attacked. (Elliott)

Illinois: Mild winter allowed a great deal of volunteer oats which were, as a rule severely infected, to live over and serve as an inoculation source for the crop. (Tehon)

Wisconsin: White Russian type most resistant. Our new Pedigree No. 12.128 showed 4%; Forward, 8%; Pedigree No. 1, 10%. (Vaughan)

In Canada and also in a few localities in the United States numerous cases were observed where infected Rhamnus was undoubtedly the source of inoculum for oats. Infection on this host was especially severe this year in North Dakota and Saskatchewan, as shown by the following reports:

North Dakota: The buckthorn hedges were severely attacked this year, more reports and specimens coming to us this year than have been received for many years. All specimens showed heavy infection, and represented localities in all sections of the state.
Crown rust was common, but no data on amount of infection are

available. Due to the irregularity of precipitation over the state, it is likely that heavy infection occurred in some fields and slight in others, similar to the wheat stem rust infections. (Weniger)

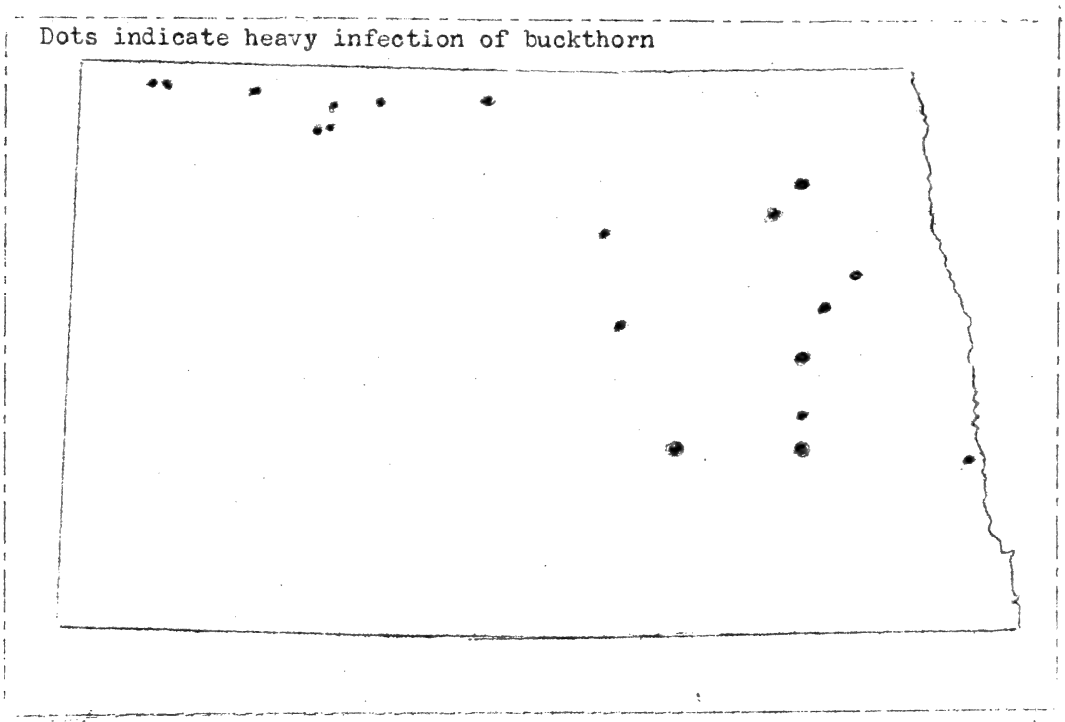


Fig. 32. Locations in North Dakota where heavy infection of crown rust occurred on buckthorn (1922), after map prepared by W. Weniger.

Saskatchewan: The aecial stage of this rust was very severe on Rhamnus carthartica in Southern Saskatchewan in early summer. It was so abundant that the buckthorns appeared yellow at some distance. It was present, but less severe, in the northern part of the province. The crown rust was very severe in Southern Saskatchewan, and extended northward as far at least as Saskatoon, but not nearly so severe as in the south. (W. P. Fraser.)

References

Melhus, I. E., S. M. Dietz and Florence Willey. Alternate hosts and biologic specialization of crown rust in America. Iowa Agr. Exp. Sta. Res. Bul. 72: 211-236. Jan. 1922.

Parker, J. H. A review of the literature on the rusts of oats, with notes on their distribution in the United States. Proc. Kansas Acad. Sci. 30 (51st-53d Ann. Meet.): 71-118. 1922.
Literature cited: p. 117-118.

OATS - Halo blight, Blast, Anthracnose

Halo-blight caused by Bacterium coronafaciens Elliott (Pseudomonas avenae Manns)

The following states reported halo-blight: New York, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Missouri, Arkansas, Idaho, and California. No losses of any consequence were recorded but in Minnesota and North Dakota the disease was more prevalent than usual. Weniger of North Dakota says it was especially prevalent early in the season at Fargo but seemed to be checked by a long period of hot, dry weather. From California, Mackie reports that the disease is carried on wild oats, Avena fatua. The attack in that state was slight but the disease was rather widespread, both in coastal areas and in the interior, especially in the Sacramento Valley.

The varieties Wisconsin 105, Wisconsin 108, and Sixty Day were reported susceptible in Minnesota, by the Section of Plant Pathology.

In a recent paper Charlotte Elliott (1) states that inoculation of oat panicles with a liquid suspension of B. coronafaciens did not result in any more sterility than when sterile water was used. It would appear, then, that this organism is not naturally an important factor in the cause of oat blast (See blast, page 230).

Reference cited:
(1) Elliott, Charlotte. Sterility of oats. U. S. Dept. Agr. Bul. 1058: Mar. 1922.

Blast (sterility) cause not determined

During the year seventeen states, ranging from New York to California and from Louisiana to Minnesota, reported losses from sterility. The following estimates of percentage reduction in yield were given: 15%, Ohio; 5%, Illinois and Kansas; 3%, Idaho; 2%, Arkansas; 1 1/2%, Louisiana, Iowa and South Dakota; 1/2%, New York, Minnesota and North Dakota. More blast than usual was reported from New York, Ohio, and South Dakota, but the other states mentioned the same, or average amounts.

During 1922 an important publication on sterility of oats (1) has appeared. In this paper it is demonstrated that spraying of plants with water at the time when the oats are coming into flower will result in sterility. The author concludes that it seems probable that rains falling about the time oats sheaths are ready to open may result in so much moisture that further development of the panicles is hindered.

Variations in susceptibility of varieties to sterility were noted by Elliott.

Reference cited:
(1) Elliott, Charlotte. Sterility of oats. U. S. Dept. Agr. Bul. 1058: 1-8. Mar. 1922.

Anthracnose caused by Colletotrichum cereale Manns

Only four states, Louisiana, Ohio, Wisconsin, and Minnesota, report traces of this disease on oats. In Minnesota it was first noted July 7 in Ramsey County, and in Wisconsin, July 15 at Madison. The state reporting the most anthracnose was Ohio where it was found in a number of fields, especially in the northern

section but the loss that resulted was slight. Negative reports were received from 18 states.

Scab caused by Gibberella saubinetii (Mont.) Sacc.

During 1922 scabbed oats were reported from the following states: New York (trace), Pennsylvania (one report from southeast), Delaware (less than last year, not noted as of any particular consequence), Kentucky (very slight importance), Ohio (very few scab infections have been observed or reported), Illinois (reported twice, certainly neither a serious nor generally encountered disease), Wisconsin (not seen except in experimental plots), Iowa (of no importance, trace loss).

From New Brunswick, Canada, G. C. Cunningham reports in the 1922 Survey of the Prevalence of Plant Diseases in the Dominion of Canada, that scab of oats was first noted as being of importance in fields on the experimental farm at Fredericton in 1920, where as high as 5% of the heads were infected. In 1922 it was observed in 5 fields out of 25 examined, averaging about 0.5 to 1%.

Miscellaneous diseases

Leaf spot caused by Helminthosporium sp. - reported from Minnesota (one report) and Idaho (not destructive).

Powdery mildew caused by Erysiphe graminis DC. W. W. Mackie in California reports powdery mildew as general in the coastal regions of the state, but not severe.

Speckled blotch of oats caused by Leptosphaeria avenaria Weber (= Septoria avenae Frank) was found near Madison, Wisconsin, in September 1921, occurring on volunteer oats at the University farm. This is apparently the first report for the United States. It has been reported previously from France, England and Germany (Weber, George F. Speckled blotch of oats caused by Leptosphaeria. In Septoria diseases of cereals. Phytopath. 12: 450-470. Oct. 1922).

Leaf spots, cause undetermined - reported from Montana, June 30, and from South Carolina, March 14.

CORN

Smut caused by Ustilago zeae (Beck) Ung.

Collaborators' estimates of losses from corn smut during 1922 are given on the accompanying map (Fig. 33). For the country as a whole the losses from this disease were less than during 1921, when it was unusually prevalent in many states. The majority of the states reported either the same amount as or less than last year, but in New England, New York, New Jersey, and Pennsylvania, and also in Iowa and North Dakota more smut than last year was reported. In South Dakota, where an epiphytotic causing a reduction in yield estimated at 15% was experienced in 1921, the disease was relatively unimportant this season, causing only a loss of about 1%.

R. S. Kirby in New York made counts of over a thousand stalks of Lewis Favorite at Mattituck, Long Island, and obtained the following results: Total percent stalks and ears smutted, 18.2 - percentage ears destroyed by smut, 3.3.

The weather and possibly other factors are quite important in influencing the amount of smut from year to year. From Wisconsinm Vaughan reports that more smut seems to occur in that state in seasons when dry weather comes early.

Fig. 33. Estimated percentages of losses from corn smut during 1922, according to collaborators.

Table 75. Dates of first appearance of corn smut 1922, according to collaborators.

May 23, Linn Co., Mo.	:July 1, Ramsey Co., Minn.	:July, Baton Rouge, La.
June 15, New Castle Co., Del.	:July 6, Laurel, N. Y.	:July, Fayetteville, Ark.
June 24, Meridian, Miss.	:July 10, Mt. Carmel, Conn.	:July, Wayne Co., Ohio
June, Sanford, Fla.	:July 29, Vermont	:July, Brookings, S. D.
July 1, Wayne Co., Ill.	:July 29, Clemson Coll., S. C.	:Aug., Fort Collins, Col.

A number of collaborators report considerably more smut in sweet corn than field corn. Other variations in susceptibility noted are as follows:

Kentucky: In self-pollinated lines marked differences are seen in susceptibility. Some lines are apparently free, others affected on certain organs, as tassel, ear, etc. (Valleau)

Kansas: Strains of corn are being developed that are found in our experimental work, to be highly resistant or susceptible. (Melchers)

Ohio: A few fields of Golden Bantam have shown 100% infection. Stowell's Evergreen, most generally grown throughout Ohio, shows only a nominal percentage. (Thomas)

CORN - Smut, Head smut, Rust, Root and Stalk rots.

Regarding the influence of fertilizer, Hoffer in Indiana reports more smut in thickly planted fertile fields. From Wisconsin the report comes that some are of the opinion that certain fertilizers make the plants more resistant.

Head smut caused by Sorosporium reilianum (Kühn) McAlp.

In 1922 this disease was only reported from the State of Washington where a field near Pullman showed a considerable amount of the disease and where occurrences were also noted in Yakima County. During the year the following publication has appeared describing the discovery of the disease on corn in Washington in 1919: Parker, C. S. Head smut of corn in Washington. Phytopath. 11: 515. Dec. 1921.

Rust caused by Puccinia sorghi Schw.

Rust was reported from practically all states east of the 100th Meridian and from Colorado. It was also collected in Manitoba, Canada, according to the Canadian Plant Disease Survey. It was generally distributed in the states from which it was reported but the only region in which it was the cause of appreciable damage was the South. In Florida the disease was rather severe in a number of places, according to O. F. Burger. In Mississippi, D. C. Neal reported it as rather severe this season in many of the southern counties, especially on late planted corn, and not only were the leaf blades rusted, but the stalks were more or less stunted because of the disease. In Louisiana, C. W. Edgerton reported the disease as abundant but probably causing less injury than in 1921, and from Texas, Taubenhaus reports rust as prevalent probably causing 1% loss. No marked differences in varietal susceptibility were reported.

During the past year a paper by Weber (1) has appeared which gives the results of studies on spore germination, overwintering, infection, and susceptibility.

References

(Cited):

(1) Weber, G. F. Studies on corn rust. Phytopath. 12: 89-97. Feb. 1922.

(Not cited):

Maneval, W. E. Germination of teliospores of rusts at Columbia, Missouri. Phytopath. 12: 471-488. Oct. 1922.

Root and stalk rots caused by various organisms

It is very difficult to distinguish between root and stalk rots caused by species of Fusarium or Gibberella and similar diseases caused by Diplodia or other organisms. The following summary pertains particularly, however, to rots caused by Gibberella and Fusarium. These diseases were reported from practically all states in the eastern part of the country and locally in Montana and Idaho. The losses are extremely difficult to estimate with any degree of accuracy, on account of the confusion with other troubles and because of the difficulty in distinguishing diseased plants. The following comments from collaborators emphasize the difficulty in estimating losses.

Kentucky: There is nothing on which losses from root rot can be based. We need more information in regard to the nature of the disease before

estimating losses. So-called root rot losses are mostly overcome by soil treatment and plenty of moisture. All corn plants have numerous root rots and the extent of injury is dependent on soil fertility, moisture, etc. (Valleau).

Mississippi: It is difficult to estimate with any degree of accuracy the percentage of injury due to root rot, since other factors such as unfavorable soil conditions, bud worms, etc., complicate the percentage of loss in poor stands, lessened yields and the like. It is also practically impossible to distinguish infected stalks from healthy ones unless the plants are pulled up and the stalks split open. In other words, it appears under our conditions that slightly infected or moderately diseased stalks reveal about the same degree of vigor as healthy plants. (Neal).

Ohio: This disease is so closely interwoven with Diplodia that it is very difficult to differentiate the actual loss occasioned by each. (Thomas).

The following comments give information concerning the importance of the disease in the various states.

Delaware: Very important. Affected crowns and nodes. (Adams).

Maryland: Very prevalent in southern counties of the Eastern Shore this year. I have seen several fields in which 25-75% of the plants were infected. (Jehle).

New Jersey: Quite important. Generally distributed over the state but more severe in the southern part. (Dept. Pl. Path.)

Pennsylvania: Coming to be recognized as an important trouble on corn. Probably worse in the southeastern part of the state. (Thurston and Orton).

West Virginia: General, but resulting damage apparently not great, due to excellent growing season. (Giddings and Sherwood).

South Carolina: Cultures made last spring from seed corn showed some of these fungi but its importance in this state is not clear. Some varieties on test at the Station showed a certain amount of broken shanks but little other evidence of infection. (Ludwig).

Florida: On May 6 practically every plant in a 35-acre field was yellow and the margins of many leaves were drying out and brown. The owner applied nitrate of soda to 30 acres at the rate of 150 pounds per acre, in addition to other fertilizers. On August 31, counts were made on both the fertilized and unfertilized land. Where no nitrate of soda was used, 36% of the stalks were barren while only 18% were sterile where nitrate was used. (W. B. Tisdale).

Ohio: Less than last year. General but worse in southern and southeastern portion of the state. (Thomas)

Illinois: Present in serious quantities. Loss this year may be as much as 8%. (Tehon).

Minnesota: Local infections in southern part of the state. (Sect. Plant Path.)

Iowa: Of slight prevalence and doubtful importance. (Melhus).

Missouri: Damage varies from slight to severe. (Maneval).

Kansas: Present in all fields. The actual damage or injury which occurred this year is problematical on account of the drouth of August. (Melchers).

The following comments concern the value of seed selection and varietal susceptibility:

Connecticut: Seem to be worse on some of Jones' crossed varieties. (Clinton).

Delaware: Seed selection by germination has effectively culled out seed ears carrying disease, giving increased yields of 2-25 bushels per acre. (Adams).

Maryland: One yellow variety showed marked resistance. This has been selected for type for many years. Sixty tests for control by seed selection were made this year with an average gain in yield of about 10%. (Temple and Jehle).

New Jersey: Plantings of tested seed gave reduction in infection. (Dept. Plant Path.)

Virginia: Seed selection has been beneficial. (Fromme).

Illinois: The yearly increased average of disease-free seed tending to reduce the disease. (Tehon).

Ear rots caused by Fusarium spp.

Rotting of the ears associated with Fusaria is perhaps another manifestation of root and stalk disease, but for various reasons it seems best to report this trouble separately.

Maine: We occasionally see a case of Fusarium ear rot but Fusarium poae (Peck) Wr. is the only species that we have isolated from corn, mostly sweet corn. (W. J. Morse).

New York: At Mattituck, Long Island, 2100 ears of Luce's Favorite were examined in September. Of the large ears 24.3% had tip infection and 5.4% butt infection. Of these infected ears 95% were infected with Fusarium moniliforme and 5% with Gibberella saubinetii. (Kirby).

New Jersey: General but severe in the southern part of the state. Plantings of tested seed showed a reduction of infected stalks amounting to as much as 50%. (Dept. Plant Path.)

CORN - Ear rots

Pennsylvania: Present and doing considerable damage. (Thurston).

Delaware: Kernel rot with Fusarium moniliforme very prevalent and most destructive with ears infested with corn ear worms. (Adams).

West Virginia: Observed generally but worse in valleys. (Giddings and Sherwood).

Kentucky: Fusarium moniliforme causes kernel injury, especially on injured ears. Gibberella saubinetii seems to be most important as a cause of ear rot each year. (Valleau).

Mississippi: All of our seed corn shows a high percentage of Fusarium moniliforme. (Neal).

Louisiana: Seventy-five to 85% of the kernels show infection by Fusaria but the loss does not seem to be heavy in proportion. (Edgerton).

Indiana: Very slight damage this year from ear rot. No corn ear worms. (Hoffer).

Iowa: Moldy ear tips general. One percent estimated loss in the state. (Melhus).

Kansas: Fusarium moniliforme very prominent. Occurs on practically every ear. (Melchers).

Recent literature:

Adams, J. F. and T. F. Manns. The corn ear worm and kernel rot of corn. Phytopath. 12: 25-26. Jan. 1922.

Dry rot or ear mold caused by Diplodia zeae (Schw.) Lev.

As a result of the prevalence of Diplodia infection on corn in 1921 throughout the greater portion of the corn belt, a large percentage of seed corn contained diseased kernels with the result that a number of states this year, particularly Ohio and Iowa, report seedling blights and root rots of corn due to Diplodia. The attack of the ears of this year's crop by Diplodia was in general much less severe than last year. The disease was reported to the Survey from Connecticut, New York, New Jersey, Delaware, Maryland, West Virginia, Virginia, Kentucky, Mississippi, Louisiana, Arkansas, Ohio, Indiana, Wisconsin, Iowa, and Kansas. From Delaware, Adams reports much more of this disease than last year and states that it was the most serious corn trouble of 1922. In that state it appeared more prevalent in fields where corn had been topped, and by count as high as 9% infection was found in some fields. In Ohio, Thomas reported that the weather of August and September was unfavorable for the spread of Diplodia, and for this reason it is believed that seed corn will carry comparatively little of the fungus. The greatest loss in that state occurred through the planting of infected seed. Estimates of loss are as follows: New Jersey, .6%; Maryland, 1%; Ohio, 3-5%; Indiana, 3-5%; Iowa, 3%; Louisiana, 5-10%; Arkansas, trace, and Kansas trace.

CORN - Dry rot or ear mold, Bacterial wilt, Brown spot

Valleau in Kentucky noted very marked differences in the number of ears affected in selfed lines. Some lines appeared entirely free while others were nearly eliminated by ear rot.

The relation of dry rot to rainfall and temperature as well as other facts concerning the disease are brought out by Melhus and Durrell (1) in Iowa circular 78.

References

(Cited):

(1) Melhus, I. E. Dry rot of corn. Iowa Agr. Exp. Sta. Circ. 78. April 1922.

(Not cited);

Johann, Helen, James G. Dickson and Grace Wineland. Relation of environment to infection of corn seedlings by Diplodia zeae (Schw.) Lév. (Abstract) Phytopath. 13: 52-53. Jan. 1923.

Bacterial wilt caused by Aplanobacter stewartii (EFS) McCul.

Reports of bacterial wilt were received during the year from New York, Maryland, Virginia, Ohio, Indiana, Illinois, Missouri, Kansas, North Dakota, and Mississippi. It was reported most commonly from Virginia and Maryland westward to Illinois, in the sweet corn canning sections. The disease is particularly one affecting sweet corn although field corn varieties are sometimes attacked. All of the collaborators reporting on varietal susceptibility mention that the Golden Bantam is most affected, while other sweet corn varieties, like Stowell's Evergreen or Country Gentleman, are not so badly attacked. One and a half percent reduction in yield of sweet corn is reported in Maryland, and 1 to 5 percent in Virginia. Two cases in Illinois were noted where 25% loss occurred while in Virginia a case of 90% infection was observed, and in Maryland 50 to 60%. Dates of first appearance were as follows: Virginia, June 16; Ohio, June; North Dakota, July 25; Maryland, July; New York, September.

According to North Dakota collaborators the disease is a comparatively new one for the state, and was observed in only a few fields this season.

Brown spot caused by Physoderma zeae-maydis Shaw

Although brown spot occurred as far north as Ohio, Indiana, Illinois, Missouri and Kansas, it was of importance only in parts of the Gulf and South Atlantic States. In South Carolina about 1% reduction in yield was estimated and in Alabama .5%, Mississippi a trace, Louisiana 1-2%, and Arkansas a trace.

The dates of first appearance reported are: May, Arkansas; June 20, A. & M. College, Mississippi; June, Sanford, Florida; July 15, Clemson College, South Carolina; July, Ohio.

In Florida the statement is made that the disease was more serious in the northern and northwestern portions of the state.

CORN - Mosaic, Bacterial stalk rot

Mosaic

During 1922 mosaic on corn was reported to the Survey only from Arkansas by H. R. Rosen. The following is an abstract of a recent paper presented by Rosen at the Atlanta meeting of the southern branch of the American Phytopathological Society, February 20-22, 1922. (Phytopath. 12: 252. May 1922).

> "Mosaic disease of corn has been noted for two successive years in northeast Arkansas. Comparatively few plants were found attacked and of these only a small number were so seriously affected as to influence the production of normal ears. Badly diseased plants are very much stunted, due principally to a shortening of upper internodes, possess chlorotic spots and stripes in great profusion, and contain a compact group of shortened leaf-blades, presenting a rosette appearance, at the top of the plant. Such plants produce abortive ears only. Present observations indicate that under Arkansas conditions the disease is not as serious or as common as in the Hawaiian Islands."

Bacterial stalk rots

In a recent paper (1) H. R. Rosen has described and named the organism causing stalk rot of corn in Arkansas and certain other states. He has given it the name Bacterium dissolvens Rosen. The following report concerning 1922 developments was submitted to the Survey by Rosen on December 13, 1922:

> "Specimens of this disease have been received this year from several localities in Illinois and in Arkansas, with reports that about one or two percent of the corn had been found with this disease. Diseased material from other states which had been suspected as being of bacterial origin, when carefully examined proved to be due to agents other than bacteria. Recent studies conducted by the writer at the University of Illinois indicate that air temperature is an important factor in the inception and development of this disease and that this malady is to be looked for only in the warmer sections of the country.
>
> "The very thorough destruction of attacked tissues, as I have previously described (Phytopath. 11: 74-79. 1921), was again evident and serves as a good distinguishing character. The disease in Arkansas has not been as serious during the last two years as it had been in 1920, doubtless due to the lack of precipitation. I wish to call attention to the fact that Dowson, in East Africa, has described a bacterial disease of field corn, which, judging from his brief account, appears to be very similar to the Arkansas disease."

Bacterial stalk rots have also been reported during the past year from Ohio, North Dajota and Arizona. It is uncertain as to whether or not these are the same as the Arkansas disease. The reports follow:

> Ohio: A more general distribution of bacterial disease of corn seems to occur this year. A limited number of cases were found during both seasons of 1920 and 1921. The causal organism is as yet undetermined. (Dept. of Botany, July 1, 1922).

CORN - Bacterial stalk rot, leaf blight.

North Dakota: A bacterial rot of field corn has been noticed for the first time in such quantity as this year. In the Fargo region, and also in many separate fields near Dickinson, the trouble I noticed was conspicuous and had attacked about 2% of the plants. The plants appear yellow, and the stalk dwarfed, rotted with a soft rot which extends from near the ground line to include the undeveloped tassel. (Weniger).

Arizona: The two plants sent in from Maricopa County by D. C. George show a bacterial stem and root rot corresponding to the description published by Rosen in an Arkansas Exp. Sta. Bul. George states that only an occasional plant shows the disease. (J. G. Brown, Aug. 1).

Reference

(1) Rosen, H. R. The bacterial pathogen of corn stalk rot. Phytopath. 12: 497-499. Oct. 1922.

Leaf blight caused by Helminthosporium turcicum Pass.

Connecticut, New Jersey, Delaware and Florida reported leaf blight during 1922. In Connecticut it was epidemic and was the worst corn disease of the year, causing an estimated loss of about 2%, according to G. P. Clinton. It was also important in New Jersey and Delaware. The heavy rains of June and July are thought to be responsible for the unusual outbreak of this disease in the North Atlantic coast states. The following statement by W. D. Valleay of Kentucky is of interest in this connection:

"Some time ago in one of the Survey reports, there was a request made for information on the Helminthosporium leaf disease of corn. I have nothing to report with regard to damage under field conditions as it apparently caused little this year, but the past summer I made some further detailed studies of seed infection in corn and determined that Helminthosporium sp. was carried in some seeds of 13 out of 15 ears studied. I have also very strong evidence that it has been present in numerous other ears that I have studied during the past three years, but I have never up to this time positively identified the organism as Helminthosporium, as under the previous conditions it did not fruit. However, it is generally the organism which causes the coal black spots or streaks in the seed coats of corn when they are grown either on sterile sand or in soil. If the plant is left in sand until death occurs, and then is allowed to remain in a few days longer, the organism, if present, will usually fruit abundantly on the seed coats, and if it has caused the death of the plant, may also fruit on the stem, between the cotyledonary node and the first node. To what extent it is the cause of the slight amount of seedling blight which occurs under field conditions, I am unable to state."

Miscellaneous diseases

Anthracnose caused by Colletotrichum graminicolum (Ces.) Wils. More abundant than usual in Connecticut, not a serious trouble, however. Reported first July 14 from Milford.

Purple sheath spot as described by Durrell (Phytopath. 10: 54-55. Jan. 1920) reported from Connecticut, Arkansas, North Dakota and Kansas. In North Dakota it seemed more conspicuous in some varieties and selections than others, according to Weniger.

Leaf spots, cause undetermined, were reported from South Carolina and Michigan.

Yellow speck, cause unknown - very common and doing some injury to the leaves of corn in Connecticut, also collected in Pennsylvania.

Blackened cob caused by Cladosporium sp. - reported on imperfectly fertilized or cured ears in Connecticut.

Black mold caused by Aspergillus niger Van Tieghem. Quite prevalent in Texas, according to Taubenhaus.

Reference:

Weston, Wm. H. Jr. The production of conidia at night in species of Sclerospora. (Abstract) Phytopath. 12: 34. Jan. 1923.

RICE

Adapted from map by O. E. Baker (A graphic summary of American agriculture. U. S. Dept. Agr. Yearbook 1921: 407-506. Tobacco, rice, flax and hemp acreage, 1919, p. 446).

Fig. 34. Rice-growing areas of the United States.

Straighthead (non-parasitic) was reported from South Carolina - "(Beaufort County); important in restricted areas. Same grower who reported injury last year reported it again this year - this time on land recently rested." (Ludwig); Louisiana - "Very common; worst in southwestern part" (Edgerton); "(Brazoria and Jefferson Counties); prevalent, loss 5% (Taubenhaus); and Arkansas - "Scattered; 50% of fields in state infested, some fields badly injured (30%); total loss 2%".(Elliott).

Blast caused by Piricularia oryzae Br. & Cav. - South Carolina (one case of slight damage in Beaufort County somewhat doubtfully placed here - Ludwig); Louisiana (common, 1 to 2% loss - Edgerton); Texas (trace - Taubenhaus); Arkansas (of no economic importance, trace - Elliott).

Foot rot caused by Rhizoctonia sp. - Arkansas (severe in some fields; 1% loss; farmers say it becomes severe in some fields after a few years, reducing the yields 50 to 60% at times, or more - Elliott).

Recent literature on diseases of rice:

Sclerotium sp.

Braganca Pereira, E. de. Sclerotium disease of rice. Philipp. Agr. 10: 331-345. Feb. 1922.

Thompstone, E. and A. M. Sawyer. The "gwabo" disease of paddy. Bul. Dept. Agr. Burma 1920. No. 16. 12 p. 1922.

Helminthosporium sp.

Nisikado, Y. and Miyake, C. Studies in the Helminthosporiose of the rice-plant. Ber. Ohara Inst. Landw. Forsch. 2: 133-195. pls. 3-9. 1922.

Ocfemia, G. O. Helminthosporium disease of rice. (Abstract) Phytopath. 13: 53. Jan. 1923.

Experimental work on disease formerly called "Sesame spot disease of rice," caused by Helminthosporium oryzae Breda de Haan.

Sundaraman, S. Helminthosporium disease of rice. Bul. Agr. Res. Inst. Pusa 128. 7 p. 1922.

Fungus is a weak parasite under normal conditions; and disease unimportant.

Miscellaneous

Shaw, F. J. F. A diseased condition of rice. Agr. Jour. India 17: 152-154. Mar. 1922.

A diseased condition of paddy, somewhat resembling straight-head, has been shown to be dependent upon a deficiency in the supply of oxygen to the roots.

Tisdale, W. H. Seedling blight and stack-burn of rice and the hot-water treatment. U. S. Dept. Agr. Bul. 116: 1-11. Nov. 1922.

Due to various fungi; most promising method of control is the development of resistant strains and varieties.

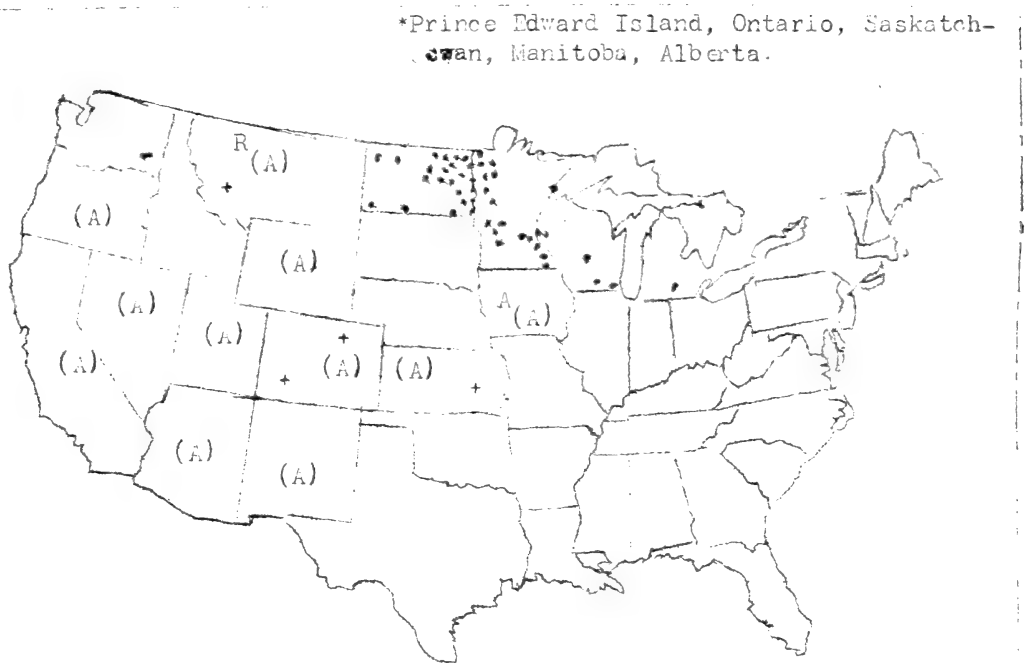
FLAX

Rust caused by Melampsora lini (Pers.) Desm.

The accompanying map (Fig. 35) indicates the distribution of flax rust, as far as it can be determined from available data.

In 1922 flax rust was reported from Wisconsin, Minnesota, North Dakota, Ontario, Prince Edward Island, and Saskatchewan. The losses caused were estimated in Wisconsin and Minnesota at a trace, and in North Dakota at 1%. The disease was severe in some fields in North Dakota, but a long period of dry weather prevented it from becoming generally serious, according to Brentzel. In Wisconsin the disease was said to be very late in developing, and Brentzel states that it appeared somewhat later than usual in North Dakota also. The dates and places of first observation reported are: July 7, Goodhue, Minnesota; July 10, Fargo, North Dakota;

North Dakota; July 28, Madison, Wisconsin.



•: Counties from which rust has been reported on cultivated flax to the Plant Disease Survey, 1904-1922.
R: Reported on cultivated flax to the Plant Disease Survey, locality not given.
A: On Linum usitatissimum,(J. C. Arthur, N. Am. Fl. 7^2: 101-102. 1907)
(A): On Linum spp.(Arthur), l. c.)
+: On Linum spp., counties (Patterson, Diehl, & Cash, U. S. D. A. Circ. 195. 1922).
*: Dominion Plant Disease Survey Annual Reports

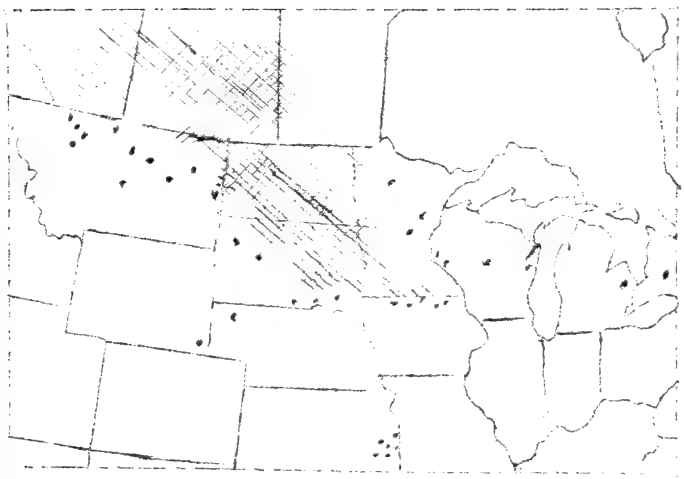
Fig. 35. Distribution of flax rust in the United States and in Canada.

In Minnesota the variety NDR #114 is said to be susceptible to rust, while Minnesota 25 is resistant, and "Argentina" immune. Brentzel reports that "Many varieties show rust infection, including many that are resistant to wilt." The following report has been supplied by H. D. Barker:

"Flax rust was reported July 7 from Goodhue County, Minnesota. Following this date it was reported from several other localities in the state. For the first time in the history of the Plant Disease Survey, flax rust was general throughout Minnesota. Usually the disease occurs quite commonly in the Red River Valley, but outside of this limited section near the border of Minnesota and North Dakota extending into the northeast corner of South Dakota, it has not, at least since I have been working on flax rust, been found to occur very abundantly. This year, however, it was general through-

out the state wherever flax was grown. In a great many fields in widely different sections of the state it appeared in epidemic form. In some fields in which it occurred quite early, much damage was done to the plants - a number of them appeared to be stunted or killed outright by the rust where it became severe.

"On a survey trip through North Dakota rust was found to be quite heavy around Fargo, extending westward throughout the state as far as Mandan. In the region of Mandan it was, however, not so severe as it was in the more humid eastern section, although it seemed to be quite generally distributed. These reports were made for the most part on seed flax types. All of the fibre varieties which were noted in the state were rusted. The damage done to fibre flax is probably greater than that occurring on seed flax, since the rust damages the quality of the fibre produced. On the seed flax, unlessit appears in epidemic form, causing such damage as is noted above, it probably does not cause severe injury. Most of the seed flax types showed varying degrees of susceptibility. Winona, Minnesota No. 182, which is also resistant to wilt, and Primost, Minnesota No. 25, were both highly resistant. The only entirely immune variety found was Argentine, a large-bolled seed flax. A large number of varieties of both seed and fibre flaxes have been tested for resistance at stations in Minnesota and in North Dakota. All of these, with the exception noted, showed varying degrees of susceptibility." (February 3, 1923).



Adapted from maps in

1. Baker, O. E. A graphic summary of American agriculture. U. S. Dept. Agr. Yearbook 1921: 407-506. (Tobacco, rice, flax, and hemp acreage, 1919, p. 446).

2. Finch, V. C., and O. E. Baker. Geography of the world's agriculture. Contribution from U. S. Dept. Agr. Office of Farm Management. 1917 (World acreage in flax, p. 57).

Fig. 36. Flax-growing areas in the United States[1] and in Canada[2].

Wilt caused by Fusarium lini Bolley

The distribution and importance of flax wilt are indicated in the following comments of collaborators:

Wisconsin: No flax diseases have been seen or reported outside of our pathological garden where a small amount of wilt was found. (Vaughan).

FLAX - Wilt, Canker, New diseases

Minnesota: General. Slightly less than last year, same as usual. Seventy-five percent of the fields in state affected, 30% in some fields. Reduction in yield 5%. (Sect. Plant Path.)

Iowa: Not important. (Melhus).

North Dakota: Less than usual, less than last year. General on old lands, particularly in the eastern part of state. Light infection except in certain fields. In some late sown fields the crop was almost a total loss. Lightness of infection probably due to weather conditions and stage of maturity. (Brentzel).

South Dakota: Unimportant, trace. Some local damage. Occasionally on old ground with strains not wilt resistant. (Evans).

Saskatchewan: Not general. Very severe in some fields in the southern part of the province. (W. P. Fraser, in Survey of the prevalance of plant diseases in the Dominion of Canada, 1922).

According to Jones and Tisdale (1), the minimum soil temperature for the development of this disease is about 14°C. (57.°F.), the maximum 38°C. (100.4°F.), and the optimum about 24° to 28°C. (75.2° to 82.4°F.) They state also that the usual midsummer temperature in North Dakota corresponds closely to the optimum for flax wilt. In this connection it is worth noting that the average July air temperature in both North Dakota and Minnesota in 1922 were below the normal for the month, and also below the average for July 1922. (Table 76).

Table 76. Comparison of normal July temperatures in North Dakota and Minnesota with the averages for 1921 and 1922.

State	July temperatures (°F)		
	Normal	Average 1921	Average 1922
North Dakota	67.5	71.4	65.6
Minnesota	69.0	74.2	67.3

Literature cited:

(1) Jones, L. R. and W. B. Tisdale. The influence of soil temperatures upon the development of flax wilt. Phytopath. 12: 409-413. Sept. 1922.

Heat canker (non-parasitic)

Heat canker was apparently of slight importance in 1922. It was reported from Minnesota and North and South Dakota.

Reference: Reddy, C. S. & Brentzel, W. E. Investigations of heat canker of flax. U. S. Dept. Agr. Bul. 1120. 1-18. Oct. 1922.

New diseases

A new disease (1) of flax, similar to if not identical with one called "pasmo" in South America, caused by ~~Phyloteena~~ Linicola Speg., has been observed to a limited extent in North Dakota for the past four years, and during the past season was found on fiber flax in Michigan. Artificial inoculations indicate that varieties differ considerably in susceptibility to this disease.

Another new disease, apparently caused by a species of Rhizoctonia, has been distinguished in eastern North Dakota (2). In the fields in which it occurred, practically every flax plant in somewhat definitely limited areas of varying

+ Phlyctaena

size was infected. The disease is destructive where it has been observed. Inoculation experiments reproduced the disease on flax but not on other plants. Minimum, optimum, and maximum growth temperatures in culture have been found to be about 13, 26, and 35°C., respectively.

Literature (Cited):

(1) Brentzel, W. E. A disease of flax not previously reported in the United States. (Abstract). Phytopath. 13: 53-54. Jan. 1923.

(2) _____ Disease of flax caused by a species of Rhizoctonia. (Abstract). Phytopath. 13: 53. Jan. 1923.

SORGHUM

Covered kernel smut caused by Sphacelotheca sorghi (Link) Clinton

Covered kernel smut was reported from Wisconsin, Kansas, Texas, Colorado, and Arizona during 1922. In Kansas, according to Melchers, it was common in fields where seed treatment was not practiced, the percentage of heads destroyed ranging from a trace to 50%, depending on the variety and conditions at planting time. The disease was prevalent in that state and also in Texas and Arizona. Varietal resistance is reported on from Wisconsin as follows:

> "Northern Amber strains apparently free from smut. Iowa Amber showed considerable. Orange Cane usually smutted. Local varieties mostly grown, hence little lost. Formalin treatment cleaned out smut on Iowa seed." (Vaughan).

Control studies being conducted in Kansas are summarized below by Melchers:

> "Extensive studies are being made of the various treatments for the control of sorghum-kernel smut. Sorghum-smut treatment plats are located in 15 different counties in Kansas. Some of these fungicides are: Chlorophol, Seed-O-San, and the Corona mercuric bichloride products. Similar studies are being made on oat smut."

Other diseases

Loose kernel smut caused by Sphacelotheca cruenta (Kühn) Potter - Reported by Taubenhaus from Texas as prevalent.

Head smut caused by Sorosporium reilianum (Kühn) McAlp. Reported from Minnesota (very serious in Waconia section where most of sorghum in state is grown), Kansas (not common, but occurring occasionally on Red Amber, a variety which seems to be most susceptible. Soils once infested seem to perpetuate the disease from season to season - Melchers), and Arizona (very rare, one head collected near St. Johns).

Blight caused by Bacillus sorghi Burr. was reported in Louisiana (common as usual), Arkansas (rather common everywhere, 1-2% reduction in yield), Wisconsin (noticeable in all fields, especially all during seedling stage. The plants seem

to recover, of minor importance), Iowa (not important), and Kansas.

Regarding this and similar diseases of sorghum, L. E. Melchers writes as follows:

> "This spot which has been thought to be caused chiefly by Bacillus sorghi is extremely common on most varieties of sorghum. Causes most injury on Sudan grass. Other varieties not materially injured. There are apparently other factors than B. sorghi concerned in the spotting of sorghum."

A decay of the stalk of sorghums was noticed this season in Kansas and reported by Melchers as follows:

> "A similar trouble has been noticed other seasons in the western part of the state. Cultural studies have given a species of Fusarium. No inoculation work has been done to prove the pathogenicity of the organism obtained. So far this trouble has not been common."

Anthracnose caused by Colletotrichum sp. Noticed on the lower leaves in a small patch of broom corn at Morgantown, West Virginia, by John L. Sheldon.

Recent literature

Kulkarni, G. S. Conditions influencing the distribution of grain smut (Sphacelotheca sorghi) of jowar (sorghum) in India. Agr. Jour. India 17: 159-162. Mar. 1922.

Rumbold, Caroline and E. K. Tisdale. Phoma insidiosa on sorghum. Phytopath. 11: 513-514. Dec. 1921.

DISEASES OF FORAGE CROPS

A. LEGUMES

ALFALFA

Leaf spot caused by Pseudopeziza medicaginis (Lib.) Sacc.

Vermont, New York, New Jersey, and Pennsylvania report more leaf spot than average this year, while in the other 19 states that have reported the disease it was prevalent in about the usual or slightly less than usual amounts.

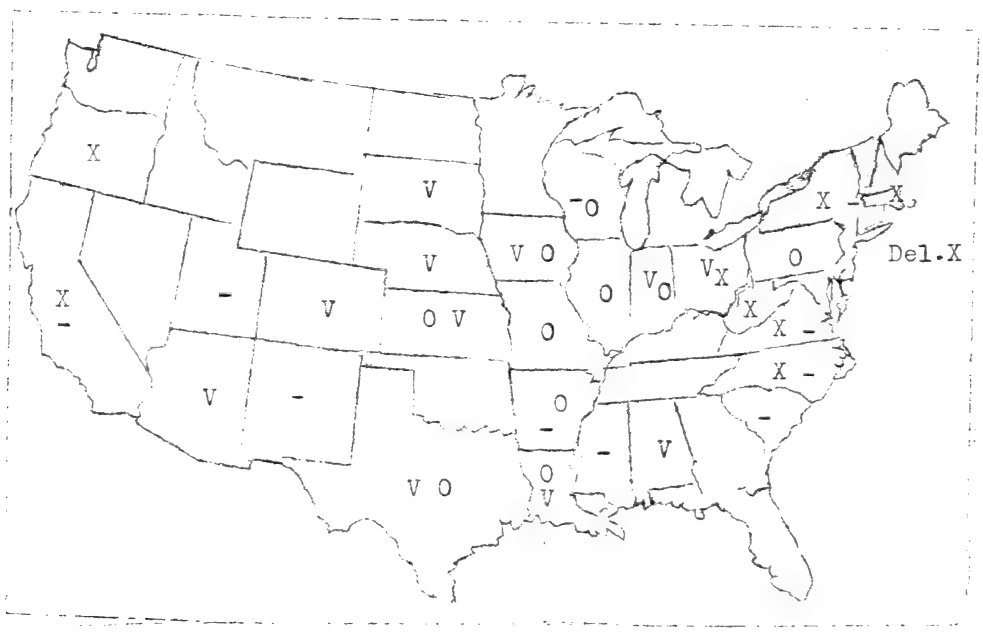
That it did some damage due to the shedding of the leaves is shown by the following estimates of losses: Vermont, 2-5% loss; Illinois, 5%; Iowa, 5%; and Missouri, 70% of the foliage destroyed in one case. The following are the dates of first appearance, according to collaborators:

April 11 - - - Virginia
May 15 - - - - Missouri
May 23 - - - - Delaware
June 15 - - - Vermont
June 17 - - - North Dakota
June 18 - - - Pennsylvania
June 29 - - - Minnesota
June (late) - Ohio
July 7 - - - Connecticut
July 18 - - - Mississippi
July 21 - - - Indiana

Two interesting notes on control measures were reported. In New York one farmer dusted his alfalfa with sulphur and reported much greener foliage, while in Wisconsin R. E. Vaughan reported the disease as not serious where ample amounts of lime have been used in the preparation of the soil.

Hardigan alfalfa is described from Michigan (Mich. Sta. Quart. Bul. 4: 74-75, 1922) as a new, hardy, disease-resisting variety developed at the experiment station as a result of 16 years breeding work. When leaf spot defoliated alfalfa in 1914 this strain was able to reset leaves on its stem and produce seed, whereas other strains sent up new growth from the roots and produced only vegetative growth.

Rust caused by Uromyces striatus Schroet. = (Uromyces medicaginis Pass.)



V: Uromyces medicaginis on Medicago sativa L. according to J. C. Arthur*
-: " " " " " " "past Survey reports
O: " " " " " " " 1922 " "
X: " " " Medicago lupulina L. " " J. C. Arthur

Fig. 37. Occurrence of Uromyces striatus (U. medicaginis) in the United States (*N. Am. Fl. 7: 256-257. Apr. 15, 1912)

ALFALFA - Rust, Yellow leaf blotch, Other diseases

The accompanying map shows the states from which alfalfa rust has been reported. It will be noted that during 1922 the states of Pennsylvania, Illinois, and Missouri reported the disease to the Survey for the first time. In Indiana this year it occurred in much greater amounts than usual in the central and northern parts of the state, where E. B. Mains found it very abundant in the fall and considered it as especially bad in 1922. In Missouri it was unusually abundant on the farm crops plots at the University of Columbia, and from Kansas, Melchers reported that the outbreak was the most severe one that has ever been noticed. Considerable loss was reported from Louisiana, in which state the disease is usually prominent, and in Arkansas considerable damage resulted from the shedding of leaves.

Yellow leaf blotch caused by Pyrenopeziza medicaginis Fckl.

This disease was reported during 1922 only from New York, Wisconsin, Idaho, and Washington. Idaho is the only state reporting it as being the cause of any particular damage and, even in that state, the losses were not appreciable.

Other diseases

Anthracnose caused by Colletotrichum trifolii Bain. -Less anthracnose than last year was reported from Arkansas but it was of greater prevalence than during the average season in that state, being severe in the early spring and causing an estimate in loss of about 5%, according to Elliott. From Mississippi it was reported in 1922 by D. C. Neal as follows: "The disease is very serious and in many fields the percentage of infection is high. The trouble is also complicated with other factors, such as girdle, hopper injury, and perhaps other fungi. The anthracnose fungus, however, is constantly present."

Bacterial blight caused by Bacterium medicaginis Sackett.- Reported from the southern irrigated sections of Idaho by C. W. Hungerford. It was prevalent in about the same amounts as usual and was not very serious.

Downy mildew caused by Peronospora trifoliorum de Bary - During 1922 downy mildew was reported from New York, South Carolina (unimportant), Wisconsin (seen in many fields but doing little damage), Minnesota (one report of light infection), Missouri, Kansas (quite common on first crop but no particular injury; favored by wet spring), Colorado, Arizona, Idaho (found in irrigated section for the most part), and Washington.

Root rot caused by Sclerotinia trifoliorum Eriks. - Virginia, Idaho and Oregon report this root rot during 1922. The Canadian Plant Disease Survey reports the occurrence of the disease in British Columbia, but no new infected areas were determined. Only slight amounts were recorded in Virginia and Idaho, but in Oregon it was reported by Barss as serious in the southern part of the state and in Malheur County; serious damage was done in some fields in the early spring. Barss writes: "Estimated damage in Josephine County last spring was 5%; average on 4000 acres of clover and alfalfa in Malheur County is reported as 50% by the county agent." (See also clover, page 253).

Root rot caused by Ozonium omnivorum Shear - Texas and Arizona are the only states reporting damage to alfalfa from this cause. In Texas it occurred especially in irrigated fields of the Rio Grande valley.

Crown wart caused by Urophlyctis alfalfae Magn. - no reports of this disease have been received from any of the states during the past year. The following publications have recently appeared:

Lina, J: A note on the biology of the "crown-gall" fungus of lucerne. Proc. Cambridge Phil. Soc. 20: 360-365. My. 1921.

Cuyot. Notes de pathologie végétale. Bul. Soc. Path. Vég. France 8: 132-136. Feb. 1922.

Bottomley, A. M. Note on Urophlyctis alfalfae on lucerne. Jour. Dept. Agric. Union South Africa 4: 153-155, 1922. The disease caused by Urophlyctis alfalfae on lucerne. Jour. Dept. Agric. South Africa 4: 153-155, 1922. - The disease caused by Urophlyctis alfalfae is described and its economic importance discussed in view of the restrictions recently imposed on the importation of lucerne seed into the Union. E. M. Doidge.

White top or yellows cause undet. - reported from Montana, Idaho, and Washington. Montana: "Very prevalent in first crop in some sections. Cause of much uneasiness; seems to be combination of environmental conditions prevalent during spring and early summer which unquestionably aggravated this trouble." H. M. Jennison. Idaho: "Fairly common; isolated plants in field affected; evidently a non-parasitic condition." - C. W. Hungerford, Idaho. In a recent bulletin from the U. S. Dept. of Agriculture (Oakley, R. A. and H. L. Westover. How to grow alfalfa. U. S. Dept. Agr. Farmers Bul. 1283: 1-36. Dec. 1922) Yellowing is listed as one of the most serious of all alfalfa troubles in the country.

Leaf spot caused by Pleosphaerulina briosiana Pol.- Collaborators in Georgia, Missouri, and Kansas report this leaf spot. From Georgia, J. H. Miller reports as follows concerning the disease; specimens of which were determined by F. R. Jones of Cotton, Truck and Forage Crop Disease Investigations: "This disease has been reported from several counties and has been most serious in all alfalfa fields on the College of Agriculture Farms. Its ravages were equally as serious as with the Pseudopeziza leaf spot. Its attacks were much worse on the first two cuttings than on the present cutting; so repeated cutting and taking the crop off the field seems to be the only effective means of control." (August 1)

Leaf spot caused by Ascochyta medicaginis Bres. - reported from Missouri by Hopkins as follows: "About five specimens of this disease have been received, but it does not appear to be doing any damage."

Leaf spot caused by Macrosporium sp. - reported only from Louisiana (abundant as usual in some cases causing severe defoliation, spots as a rule following insect punctures - Edgerton), and from Missouri (one report, loss slight - Maneval).

Leaf spot caused by Cercospora medicaginis E. & E. - traces of this disease were reported from Texas and Missouri.

Violet root rot caused by Rhizoctonia medicaginis (DC.) Tul.- reported from Iowa (more; serious locally - Melhus), and Kansas (apparently not any more prevalent than in other seasons. Most conspicuous in old fields along river valleys and creek bottoms - Melchers).

Root rot, cause undet. - an unknown root rot is reported by C. D. Learn from Colorado as important, and from Idaho, C. W. Hungerford writes: "Reported from nearly every part of state where alfalfa is grown. It is becoming more prevalent each year. A species of Fusarium has been quite constantly isolated from diseased plants."

Root knot caused by Heterodera radicicola (Greef) Müll. - reported from Texas by Taubenhaus who states that the variety Hairy Peruvian is highly resistant.

Dodder (Cuscuta spp.) - reported from Texas, Washington and Arizona.

Girdle (cause undet.) - the following paper on this disease has appeared during the year:

Brown, J. G. & Frederick Gibson. Some observations on alfalfa girdle. Phytopath. 12: 188-190. April. 1922.

CLOVER

Powdery mildew caused by Erysiphe sp.

Probably the most noteworthy plant outbreak of the year was that of powdery mildew of red clover. In 1921 it appeared in unprecedented amounts in states in the northeastern quarter of the country, but during 1922 it was much more widely distributed and occurred all over eastern United States from South to North and in eastern Canada. The accompanying map shows the geographical range of the disease. On the western limits it was reported only from the eastern parts od the Dakotas and Kansas. Apparently, it did not extend beyond the line of the 100th meridian.

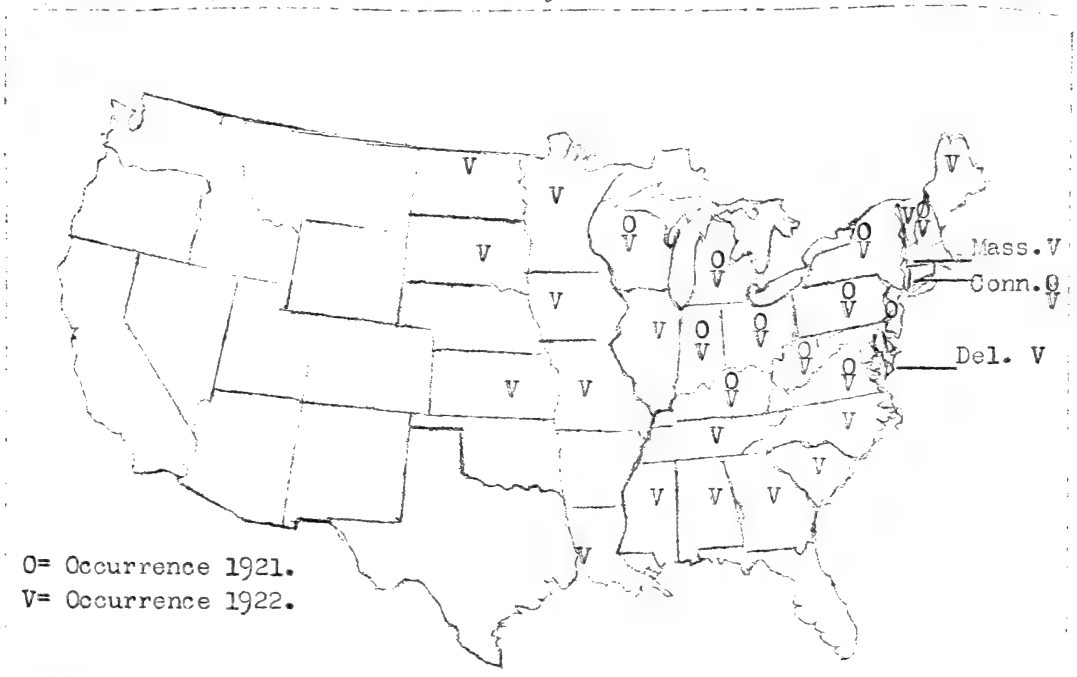


Fig. 38. Distribution of powdery mildew of clover in the United States, as reported by collaborators of the Plant Disease Survey, 1921 and 1922.

It appeared first in the southern states early in April and then as the crop developed, was reported farther northward appearing in the northern states during June. Whether or not this progression from south to north indicates spread in the same direction is uncertain. It is more probable that the fungus was well distributed and made its first appearance in the various places at the time when weather conditions favored. However, considerable spread undoubtedly took place during the year. A number of collaborators mention the appearance of the mildew in a portion of a state, with subsequent appearance in other parts.

The reasons for the unusual outbreak of this disease during the past two years is still somewhat in doubt. It may be that peculiar climatic conditions have favored the unusual development and spread of a native powdery mildew. On the other hand, there are good reasons to suppose, particularly on account of the conspicuous character of the mildew, its apparent invasion of new localities, and because of the fact that our native clovers are susceptible, whereas European ones

are resistant, that we have to deal with an introduced parasite which has found conditions especially favorable in the United States.

Statements concerning the losses and conditions in the individual states have already been made available (1 and 2). For the most part the actual loss was probably not large, but undoubtedly there was considerable reduction in yield in many fields on account of stunting of plants and shattering of leaves. Considerable alarm was manifested by farmers in many localities on account of possible injury to stock that was fed mildewed clover hay. However, no actual cases of stock poisoning from this cause were found and feeding experiments conducted with horses, cattle, sheep and swine at the Tennesseee Experiment Station resulted in no harmful effects.

Dates of first appearance of powdery mildew, 1922.

April 10..... Louisiana	June 1 ..... Union Center, Wis.
April ..... Fayetteville, Ark.	June 6 ..... Wayne Co., Ohio
May 1 ..... Rome	June 7 ..... Rice Co., Minn.
May 11 ..... Bedford, Va.	June 10 ..... Orange Co., N. Y.
May 15 ..... Southern Indiana	June 13 ..... E. Spartanburg, S.C.
May 18 ..... Poplar Bluff, Mo.	June 15 ..... New Haven, Conn.
June ..... Delaware	June 15 ..... Doniphan Co., Kans.
June 1 ..... East Kingston, N. H.	July (early) .. Vermont

The correct name for this mildew still remains in doubt, since the perithecial stage does not seem to have been collected during the past two years. The perfect stage of Erysiphe polygoni DC. has been collected on red clover in a number of the western states and in West Virginia and possibly other states in years past. However, it is not unlikely that the present organism is another mildew or another strain of the same species.

American red clovers and the mammoth or sapling clover are the varieties that are most universally attacked. It was seen on alsike clover by collaborators in New York, West Virginia, Pennsylvania and Wisconsin, but this host was very slightly and only rarely infected. White clover was also found affected in West Virginia by John L. Sheldon. According to him it was not common near Morgantown, but often present, especially when near red clover.

The following comment by John Monteith and the table by E. B. Mains, giving results of varietal tests at Lafayette, Indiana, shows that the American red clovers at Lafayette are susceptible, whereas those from Europe and Chile are immune or resistant:

> "There is marked resistance to mildew shown in the European clovers as compared with our home grown stock. This has been true in every one of Dr. Pieter's plantings that I have visited. This should not, however, be reported in a way that would give the impression that the foreign stock is therefore to be desired. Our home grown stock appears to be more resistant to anthracnose in some cases, is more hardy in northern sections and seems better able to stand the summer conditions farther south. So the factor of resistance to mildew is outweighed by other objections to their general use."

CLOVER - Powdery mildew

Table 77. Susceptibility of clovers to powdery mildew, Lafayette, Indiana, Oct. 12, 1922 (To be published in Proc. Ind. Acad. Sci. 1922) by Dr. E. B. Mains.

Species and variety	Original source of seed.	No. plants examined	Degree of susceptibility (no. plants)			
			Heavy	Moderate	Slight	None
Trifolium pratense 2019	S. Dakota	44	13	22	9	0
" " 2020	Ohio	44	9	15	19	1
" " 1809	N. Dakota	9	2	0	7	0
" " 2055	Chile	17	0	1	16	0
" " 1819	Italy	10	0	0	8	2
" "	France	44	0	0	15	29
" " 43592	England	10	0	0	0	10
Trifolium incarnatum 2054		10	0	0	0	12
Trifolium hybridum 2047		12	0	0	0	12
Trifolium repens 48625	Holland	8	0	0	0	8
" " 1928	Wisconsin	10	0	0	0	10
" " 1912	Idaho	25	0	0	0	25
" " 48019	England	12	0	0	0	12
Trifolium subterraneanum 51212		10	0	0	0	10
Trifolium fragiferum 29012		12	0	0	0	12
Trifolium reflexum 03308		12	0	0	0	12

Seed obtained from Dr. A. J. Pieters, Office of Forage Crop Investigations, U. S. Department of Agriculture. Numbers are those used by that Office.

CLOVER - Rusts, Root rots

Rusts caused by Uromyces spp.

Uromyces fallens (Desm.) Kern was reported on red clover from New England, West Virginia, Kentucky, South Carolina, Ohio, Indiana, Illinois, Missouri, Wisconsin, Minnesota, North Dakota, Idaho, and from Alberta and Manitoba, Canada. The disease is not destructive, but the combination of rust and powdery mildew undoubtedly caused some damage. In Kentucky, Valleau noted certain red clover plants on October 3 that were heavily infected with rust, while neighboring plants were entirely free. From Idaho, Hungerford writes that one field near Parma was severely attacked.

Uromyces trifolii (Hedw. f.) Lév. was reported on white clover from Connecticut, Minnesota, Iowa, Missouri, and Manitoba, and on alsike clover from Connecticut, Minnesota and Manitoba.

Uromyces elegans (Berk. & Curt.) Lagh. (Puccíniola elegans (Berk. & Curt.) Arth) was reported on Trifolium carolinianum by Ludwig from South Carolina as of some economic importance owing to the value of the host for grazing purposes. A case was reported of badly affected spots in pastures with reduction in amount of foliage produced.

Root rots caused by various organisms

Root rot caused by Sclerotinia trifoliorum Eriks. This disease was reported from Ohio, Wisconsin, Idaho, and Oregon during the year. In Ohio there has been an increase of this root rot as compared with that caused by Fusarium. It is important mainly in the northwestern part of the state. In Oregon the disease was said to be the cause of considerable damage in the western and southern parts of the state.

Root rot caused by Fusarium sp. This root rot is reported from Ohio and Idaho in both of which states it was regarded as important.

A root rot the cause of which has not been determined was also reported as serious in Kentucky. Regarding this, Valleau sends the following statement:

> "During the past two years Fergus and Valleau have conducted extensive studies of the root systems of red clover, especially, but also white, sweet, alsike and crimson clovers and alfalfa, and have found on hundreds of plants examined always many small roots dead and being replaced by new ones. Tap roots of red clover and alsike become badly discolored either the first summer or the second and then plants live on crown roots entirely. This seems to be the cause of great mortality in certain fields the first summer and to be the cause of red clover acting as a biennial over the greater part of the country.
>
> "The extent of injury to the roots is directly correlated with the soil treatment. This part of the problem is being studied on the soil fields distributed in various soil areas of Kentucky. Lime materially reduces the injury the first summer. Lime and acid phosphate greatly reduce the injury. On blue grass soil in central Kentucky there is generally very slight injury the first season. On all soils and with all treatments there is a very serious injury the second year.
>
> "The disease seems always to be present on all clovers, but the extent of injury is dependent on rate of growth of the plant and this is dependent on soil fertility."

Reference

Selby, A. D., and R. C. Thomas. Impairment of clover seedlings reported. Monthly Bull. Ohio Agric. Sta. 6: 90-92. 1921. Fusarium sp. has consistently been associated with a root-rot disease of red clover in Ohio.

Nematode disease caused by Tylenchus dipsaci (Kühn) Bastian

The nematode disease of red clover was reported only from Idaho during 1922. In a recent publication from Idaho (1) infection is reported as having been secured on the following plants by growing them in infested soil: Beans, peas, fall vetch, Egyptian clover, and alsike clover. Varietal tests conducted at the Rothamstead Experiment Station by Goodey (2) gave the following results with regard to susceptibility:

Group 1, very susceptible:
- Red clover - Canadian, French and English.
- Cow-grass - Swedish.
- Kidney vetch.

Group 2, much less susceptible:
- Cow-grass - English.
- Alsike clover - Canadian and English.

Group 3, very slightly susceptible:
- Sainfoin.
- White clover - Wild Cotswold, English, and Wild Kentish.

Group 4, apparently immune:
- White clover - Sutton's Mammoth.
- Lucerne - Provence.
- Trefoil.

Literature cited:

(1) Smith, R. M. The eelworm disease of red clover. Idaho Agr. Exp. Sta. Bul. 130: 1-14. Mar. 1922.

(2) Goodey, T. On the susceptibility of clover and some other legumes to stem-diseases caused by the eelworm, Tylenchus dipsaci, syn. devastatrix, Kühn. Jour. Agr. Sci. 12: 20-30. Feb. 24, 1922.

Miscellaneous diseases

Anthracnose caused by Colletotrichum trifolii Bain - reported only from Ohio where it was serious in a few fields in the western part of the state.

Leaf spot caused by Pseudopeziza trifolii (Bernh.) Fckl. - reported from Ohio, Wisconsin and New Brunswick.

Leaf spot caused by Sphaerulina trifolii E. Rostr. - was reported on for the first time in the United States by E. F. Hopkins at the Boston meeting. He has observed it in Missouri, Illinois, and New York, principally on white clover, but red and alsike clover have also been found infected. The disease was collected in Columbia, Missouri as early as 1902. It was first observed this year in Missouri by Hopkins on March 18. (Hopkins, E. F. The Sphaerulina trifolii leaf spot of clover. (Abstract). Phytopath 13: 59. Jan. 1923.)

CLOVER, SWEET CLOVER, BUR CLOVER

CLOVER

Leaf spot caused by Macrosporium sp. - abundant and widely distributed in Louisiana and occurring also in Ohio and Minnesota

Sooty spot caused by Phyllachora trifolii Pers. (Fckl.) = (Polythrincium trifolii) Kuntze - reported from Vermont, Connecticut, Ohio, Illinois, Minnesota, and Canada on both white and red clover. L. R. Tehon in Illinois writes as follows concerning this disease:

> "It is a matter of interest to me to find that in the western part of Illinois, particularly in Madison, St. Clair, Jersey, Menard, Tazewell, and Calhoun Counties, the white clover used largely for pasture purposes is covered to a large extent with the mold Polythrincium trifolii. Practically all pastures where this clover is grown are infested. The infection of plants varies from 30 to 70% and from 60 to 70% of the leaves on these plants are affected with reduction of photosynthetic surface of from 2 to 30%."

Spot caused by Cercospora sp. - reported from Delaware (affecting stems) and from Missouri (causing slight damage to the leaves).

Mosaic - reported on red clover, particularly from Connecticut, Arkansas, Indiana, Wisconsin, and Minnesota, and, according to the Canadian Plant Disease Survey, from Quebec and Manitoba. References: (Dickson, E. T. and E. G. Hood. Temperature studies in mosaic diseases. (Abstract). Phytopath. 13: 42. Jan. 1923. Nelson, Ray. The occurrence of protozoa in plants affected with mosaic and related diseases. (Abstract). Phytopath. 13: 41. Jan. 1923).

Dodder (Cuscuta sp) - reported from Louisiana, (one field very bad).

SWEET CLOVER (Melilotus spp.)

Leaf spot and stem rot caused by Ascochyta caulicola Laub. - reported as abundant and causing considerable defoliation on the Experiment Station plots and at one place in Boone County, Missouri (Hopkins, Maneval); found in a few fields near Fargo, North Dakota, where it appears rather late, and seems to cause a blasting of the seed in seed fields. (Weniger).

Anthracnose caused by Colletotrichum trifolii Bain - Kendall County, Illinois. (Tehon).

Anthracnose caused by Cloeosporium caulivorum Kirch - Kankakee County, Illinois. (Tehon).

Root rot caused by Fusarium sp. - one severely (10-20%) affected field found in Williams County, North Dakota; cool, damp weather favorable. (Weniger).

Mosaic - observed on practically every plant in the vicinity of University Farm, Minnesota (Sect. Plant Path.).

Wilt (undet.) - East Baton Rouge Parish, Louisiana; common, some loss (Edgerton).

Root knot caused by Heterodera radicicola (Greef) Müll. - northwestern South Carolina (Ludwig).

BUR CLOVER (Medicago hispida gaertn.)

Leaf spot caused by Macrosporium sp. - abundant on bur clover in East Baton Rouge Parish, Louisiana; affecting nearly all of the crop but not causing much loss (Edgerton).

COWPEA

Leaf spot caused by Cercospora cruenta Sacc. - Delaware, Texas (four counties, prevalent, 1% loss - Taubenhaus), Illinois (first report for Illinois, collected once only, at Makanda, Jackson County, August 19; slight -(Anderson and Tehon).

Leaf spot caused by Amerosporium oeconomicum E. & T. - general but not important in Delaware (Adams).

Alternaria atrans Gibson following sunburn and aphid injury on Blackeye cowpea, Arizona; (see soybean).

Powdery mildew caused by Erysiphe polygoni DC. - unimportant in Delaware and South Carolina; severe, causing defoliation in greenhouse at LaFayette, Indiana. (Gardner).

Rust caused by Uromyces appendiculatus (Pers.) Lév. - Texas.

Bacterial spot caused by Bacterium vignae Gardner & Kendrick is said to be widespread in Indiana, where it has been observed since 1919. The disease is rather destructive, but it was less important in 1922 than usual. The organism causes leaf and pod spotting, malformation of the pods, and blight of seedlings grown from infected seed. According to the authors, the organism is seed borne, and probably the use of seed from disease-free pods will control it. (Gardner, Max W., and James B. Kendrick. Bacterial spot of cowpea. Science n. s. 57: 275. March 2, 1923).

Mosaic - fairly important in Arkansas (Elliott); unimportant and rare in Indiana. (Gardner).

Wilt caused by Fusarium vasinfectum Atk.- northern South Carolina (important; importance not to be judged by number of complaints, as disease makes it necessary to raise only resistant varieties of both cotton and cowpeas - Ludwig), Arkansas.

Root rot caused by Ozonium omnivorum Shear - prevalent in Texas. (Taubenhaus).

SOYBEAN

Bacterial leaf spots: Bacterial pustule caused by Bacterium phaseoli var. sojense Hedges - was abundant in East Baton Rouge Parish, Louisiana, where it was first observed on June 21, affecting practically all of the crop, and causing a loss estimated at 3 to 5%. (Edgerton). According to Miss Hedges (5), this organism was first isolated in 1917 from Texas material. and has been found to occur from Washington southward. Bacterial blight caused by Bacterium glycineum Coerper,- reported from Steuben and White Counties, Indiana. Undetermined bacterial leaf spots have been reported from Delaware (leaf infection prevalent in all fields; not determined, probably bacterial; has been considered as due to B. lathyri but not confirmed by culture work - Adams) and Virginia (general and causing severe damage - Fromme).

Bacterial wilts: Bacterium solanacearum EFS has been found on soybean in North Carolina, according to F. A. Wolf (7). Diseased specimens were received from Columbus in August, 1921. While wilting is not a prominent symptom in the case of this host, probably because of the woody nature of the stems and petioles, the affected plants are dwarfed and the foliage is prematurely killed. The organism causing the new bacterial wilt of the bean, Bacterium flaccumfaciens, described by Miss Hedges, was successfully inoculated into the Ito San variety of soy bean (4).

Downy mildew caused by Peronospora sp. is reported by F. R. Perry from Genesee County, New York. This is the first report of a downy mildew on soybean received by the Survey, and apparently it is the first report for the United

States. According to E. J. Butler (1) Peronospora trifoliorum de Bary occurs on soybean in the province of Kashmir in India, and has been reported on this host from Formosa also; and P. trifoliorum var. manshurica Naoumoff has been described on soybean from Russian Manchuria.

Pod and stem blight caused by Phomopsis sojae Lehman has been described from North Carolina (6).. It had been reported as due to Phoma sp. in 1920 by Wolf and Lehman (8). According to Lehman the causal fungus attacks pods, stems, and sometimes leaves. The pods are penetrated and the seeds invaded by the organism. The fungus overwinters in diseased stems and seed. The disease is said to be capable, especially in wet seasons, of causing serious damage to this host, and the use of disease-free seed, crop rotation, and the plowing under of diseased plants after harvest are recommended for its control.

Wilt caused by Fusarium sp. - Botetourt County, Virginia; Hampton County, South Carolina, and Lewiston, Missouri.

Wilt caused by Sclerotium rolfsii Sacc. - occasional, causing a loss of less than 1% in East Baton Rouge Parish, Louisiana.(Edgerton).

Mosaic was reported from Indiana again, and for the first time from Connecticut, New York, Virginia, Kentucky, and Louisiana. Indiana, Pennsylvania and North Carolina were the only states from which soybean mosaic had previously been reported to the Survey. There may be some question as to whether some of the mosaic reported may not really be a trouble similar to that occurring in Delaware, which Adams says is due to unbalanced nutrition (see necrosis). The Indiana disease has been proved by transmission experiments, however, to be a true mosaic (2). The following notes concerning the relative susceptibility of varieties to mosaic are interesting:

New York (Riverhead, L. I.): Soy bean mosaic was observed in a variety test plot and data as follows were taken: 100% of the plants of the varieties Black Eyebrow, Manchu, Mandarin, Wilson, and Virginia were diseased; while only 20% of those of the Peking veriaty were affected. (E. E. Clayton, July 24).

Kentucky: Noticed for first time at Experiment Station. Mammoth Yellow appeared very susceptible. (Valleau).

Indiana: Worst in Hollybrook variety, severe in Haberlandt, and occurs in a number of other varieties tested. Reduces yield severely. (Gardner).

Necrosis, due to unbalanced nutrition, which is reported from Delaware as general and very important in some sections is described by Adams as follows:

> "A chlorosis on soybean leaves has been observed the past two seasons resembling mosaic symptoms. Along with the mottled appearance of the leaves an atrophy of the terminal growth occurs. About the time of maturing a conspicuous 'firing' of the leaves occurs, and in some instances a pronounded prematuring. The lower leaves on such plants showed no symptoms of chlorosis. The disturbance was found to be entirely associated with the food requirements, particularly where potash was deficient."

Alternaria atrans Gibson (3),following sunburn and aphid injury and causing a leaf-spot with resultant loss of foliage, is said to be of considerable importance in southern Arizona. The variety Virginia is affected badly enough every year to lessen seriously its value for any purpose in that region, while Biloxi was the most resistant variety found. None of the varieties studied, in-

cluding besides the two already mentioned, Otootan, Barchet, Shanghai, Tokio, and Peking soybeans, and Blackeye cowpeas, were immune to the disease.

Literature cited:

(1) Butler, E. J. Soybean: downy mildew. In Fungi and disease in plants, pp. 266-267. Thacker, Spink and Co., Calcutta and Simla. 1918.
References given under soybean downy mildew:
Sydow & Butler: Fungi Indiae Orientalis, IV; Ann. Myc., X.
Naoumoff: Fungi Ussuriensis; Bul. Soc. Myc. Fr., XXX.
Parasitic fungi of Formosa; Bot. Mag., Tokyo, XXVIII, p. (423).

(2) Gardner, Max W., and James B. Kendrick. Soybean mosaic. Jour. Agr. Res. 22: 111-113. Oct. 8, 1921.

(3) Gibson, Frederick. Sunburn and aphid injury of soybeans and cowpeas. Arizona Agr. Exp. Sta. Tech. Bul. 2: 41-46. Sept. 1922.

(4) Hedges, Florence. A bacterial wilt of the bean caused by Bacterium flaccumfaciens nov. sp. Science n. s. 55: 433-434. Apr. 21, 1922.

(5) _____ Bacterial pustule of soybean. Science n. s. 56: 111-112. July 28, 1922.

(6) Lehman, S. G. Pod and stem blight of the soybean. Jour. Elisha Mitchell Sci. Soc. 38: 13. Sept. 1922.
(Abstract of paper read before 21st ann. meet. North Carolina Acad. Sci. May, 1922).

(7) Wolf, F. A. Additional hosts for Bacterium solanacearum. Phytopath. 12: 98-99. Feb. 1922.

(8) _____, and S. G. Lehman. Notes on new or little known plant diseases in North Carolina in 1920. In North Carolina Agr. Exp. Sta. Ann. Rept. 43: 58. 1920.

VETCH (Vicia sp.)

Protocoronospora nigricans Atk. & Edg. - very common but causing slight loss in East Baton Rouge Parish, Louisiana. (Edgerton).

VELVET BEAN (Stizolobium spp.)

Bacterial leaf spot caused by Bacterium sp. - common in Louisiana.

Leaf spot caused by Cercospora stizolobii Syd. was found at Barnwell, South Carolina, in September. According to Anna E. Jenkins (1), of the Office of Pathological Collections, there are specimens of this disease in the Pathological Herbarium from North Carolina (1921), Florida (1901 and 1921), and the Philippine Islands (type locality); and specimens collected in Porto Rico by J. A. Stevenson in 1914 and 1916 on Stizolobium sp., and by F. L. Stevens on S. pruriens are considered to be of the same species. In the Survey files there is a report from C. L. Peltier of Cercospora sp. on velvet bean occurring in 1917 for the first time in Alabama.

Stem rot (cause unknown) - Barnwell County, South Carolina; unimportant.

Root knot caused by Heterodera radicicola (Greef) Müll. - According to the results of experiments conducted at the Florida Experiment Station (2) growing bunch velvet beans for one season, during which they are kept cleanly cultivated, greatly reduces the number of nematodes and makes it possible to grow snap beans the following season.

Literature cited:

(1) U. S. Dept. Agr. Office Path. Col. Pathological Herbarium Notes 4: 11. April 1, 1922.

(2) Watson, J. R. Bunch velvet beans to control root-knot. Florida Agr. Exp. Sta. Bul. 163: 55-59. June 1922.

HORSE BEAN (Vicia faba)

Chocolate spot or streak disease caused by Bacillus lathyri Manns & Taubenhaus has been reported from England and Wales (1). It is said not to be especially important except under exceptional conditions of hot, moist weather.

Literature cited:

(1) Paine, S. G. and M. S. Lacey. Chocolate spot or streak disease of broad beans. Jour. Min. Agr. Great Britain 29: 175-177. May 1922.

B. SUNFLOWER

Rust caused by Puccinia helianthi Schw. was reported from Connecticut, Delaware, Wisconsin (may be some loss when grown for silage by loss of lower leaves; of minor importance as a rule), Minnesota, Colorado, California (common in the interior valley on wild sunflowers; found at Manteca, San Joaquin County, on cultivated sunflowers causing only slight injury), and by the Dominion Plant Disease Survey from Quebec, Ontario, Manitoba, and Saskatchewan (1).

Wilt caused by Sclerotinia sp. was not reported to the Survey in 1922. In Canada, however, according to the Dominion Plant Disease Survey report (1), it occurred in Quebec, Ontario, Manitoba, and British Columbia, but was not of general importance except in Quebec.

Powdery mildew caused by Erysiphe cichoracearum DC. - Connecticut, Washington, Manitoba (1).

Downy mildew caused by Plasmopara halstedii (Farl.) Berl. & de Toni - Tipton County, Indiana.

Leaf spot caused by Septoria helianthi E. & K. - Connecticut, Minnesota.

Dodder (Cuscuta sp.) - Whitman County, Washington.

Literature cited:

(1) Drayton, F. L., compiler. Survey of the prevalence of plant diseases in the Dominion of Canada, 1922. Third Ann. Rept. (mimeographed). Division of Botany, Experimental Farms Branch, Dept. Agr. 1922.

C. GRASSES

TIMOTHY

Rust caused by Puccinia phlei-pratensis Eriks. & Henn. was reported from New York, West Virginia, Minnesota, Iowa, North Dakota, and Oregon.

Leaf spot caused by Scolecotrichum graminis Fckl. - Anoka County, Minnesota, June 22.

Smut caused by Ustilago striaeformis (Westd.) Niessl was reported from New York (in private lawn at Ithaca, June), Iowa, North Dakota, and Skagit County, Washington.

Recent literature:

Davis, W. H. Germination of the spores of timothy smut (Ustilago striaeformis (Westd.) Niessl.). (Abstract). Phytopath. 13: 38-39. Jan. 1923.

Leaf spot caused by Heterosporium phlei Gregory - Laurel, New York, July 6.

Zonate eye-spot caused by Helminthosporium giganteum H. & W. - see under miscellaneous grasses.

Take-all caused by Ophiobolus cariceti (Berk. & Br.) Sacc. - Cayuga and Tompkins Counties, New York; found only in badly diseased (take-all) wheat fields. (Kirby & Barrus).

Proliferation of spike (physiological) - North Branford, Connecticut, October 26. Glumes turned into leaves. (Clinton).

SUDAN GRASS (Holcus sorghum sudanensis (Piper) Hitchc.)

Bacterial blight caused by Bacillus sorghi Burr. - found in serious form at Yuma, Arizona.(D. C. George).

Anthracnose caused by Colletotrichum cereale Manns - North Dakota.

MISCELLANEOUS GRASSES

Brown patch caused by Rhizoctonia solani Kühn

Clinton reports that in Connecticut this disease gave much trouble in lawns early in the season, which was wet. However, it was not always possible to find a fungus as the cause of the trouble. He thinks that winter injury and sunscorch are probably contributing causes. Fescue, red top, and bent were the grasses most injured by the disease in Connecticut, while blue grass was not much damaged.

The use of Bordeaux, either dry or liquid, has been reported to give good results in the control of this disease (1). The grass should be kept covered with the spray until late in the season; during the most dangerous periods (moist hot weather) the Bordeaux should be applied every two or three days, and in no case should there be longer than a week between applications. After every rain or watering a new application should be made.

Literature cited:

(1) Carrier, Lyman. Brown-patch and the Bordeaux treatment. Bul. Green Sect. U. S. Golf Assoc. 2: 109-116. April 1922.

Claviceps purpurea (Fr.) Tul.

Agropyron repens (L.) Beauv. - New York, Saskatchwean (2)
Agropyron smithii Rydb. - Saskatchewan (2)
Calamagrostis americana Scrib. - Saskatchewan (2)
Elymus macounii Vasey - Saskatchewan (2)
Spartina pectinata Bosc. - Saskatchewan (2)

Erysiphe graminis DC.

Agropyron repens (L.) Beauv. - New York, Minnesota
Agropyron tenerum Vasey - Minnesota
Agrostis palustris Huds. (A. alba) - Minnesota
Dactylis glomerata L. - Minnesota
Elymus canadensis L. - Minnesota
Poa pratensis L. - Minnesota, Missouri

Helminthosporium bromi Died.

Bromus inermis Leyss. - Minnesota, North Dakota (severe early in season).

Helminthosporium giganteum H. & W. (4)

near Washington, D. C., on:
Agropyron elongatum Host - severe
Agropyron intermedium Beauv. - severe.
Agropyron repens (L.) Beauv. - severe
Agrostis stolonifera L. - moderate
Bromus inermis Leyss. - severe
Capriola dactylon (L.) Kuntze = (Cynodon dactylon L.) - very severe.
Eleusine indica (L.) Gaertn. - severe
Elymus virginicus L. - moderate
Eragrostis cilianensis (All.) Link = (E. major Host) - slight
Eragrostis pectinacea (Michx.) Nees - slight
Homalocenchrus virginicus (Willd.) Britton = (Leersia virginica Willd.) - moderate
Lasiagrostis splendens Kunth - severe
Muhlenbergia mexicana (L.) Trin. - slight
Muhlenbergia schreberi Gmel. - slight
Panicum anceps Michx. - slight
Panicum clandestinum L. - slight
Panicum dichotomiflorum Michx. - slight
Panicum gattingeri Nash - slight
Pennisetum japonicum Trin. - slight
Phalaris arundinacea L. - very severe
Phleum pratense L. - slight
Poa pratensis L. - slight

MISCELLANEOUS GRASSES

Helminthosporium ravenelii M. A. Curtis

Sporobolus berteroanus (Trin.) Hitch. & Chase - Florida (very severe)

Helminthosporium sp.

Poa pratensis L. - Connecticut (Same disease as the one reported by Drechsler (3) as having been found in Wisconsin, Illinois, New York, Connecticut, Massachusetts, Maine, Maryland, Virginia).

Ophiobolus cariceti (Berk. & Br.) Sacc.

Reported by Kirby from New York on:
Agropyron repens (L.) Beauv. - very important as a harborer of this disease.
Agrostis palustris Huds. (A. alba) - only in take-all infested wheat fields.
Bromus secalinus L. - only in take-all infested spots in wheat fields.
Poa compressa L. - new on this host; important as a take-all host.

Phyllachora graminis (Pers.) Fckl.

Agropyron repens (L.) Beauv. - Minnesota
Elymus canadensis L. - New York, Minnesota
Hystrix patula Moench - Minnesota
Muhlenbergia sp. - Minnesota

Physarum cinereum (Batsch) Pers.

Lawn grasses - Connecticut (injury slight, mechanical)

Piricularia grisea (Cke.) Sacc.

Syntherisma sanguinalis (L.) Dulac (Digitaria sanguinalis Scop.) - Illinois.

Puccinia clematidis (DC.) Lagerh.

Reported from Manitoba by V. W. Jackson (2) on:
Agropyron tenerum Vasey
Agropyron spp.
Bromus spp.
Elymus spp.

Puccinia coronata Cda.

Avena sp. (wild oats) - Minnesota
Festuca elatior L. - New York

Puccinia cynodontis Lacroix

Capriola dactylon (L.) Kuntze - Florida

MISCELLANEOUS GRASSES

Puccinia glumarum (Schm.) Erikss. & Henn.

(* - New hosts determined by artificial inoculation, reported by Hungerford, Idaho)

*Agropyron acutum C. Koch
*Agropyron longifolium
*Agropyron tenerum longifolium
*Bromus adoënsis Hochst.
*Bromus erectus Huds.
*Bromus lanuginosus Poir.
*Bromus macrostachys Desf.
*Bromus maximus Desf.
*Bromus porteri frondosus
*Bromus purgans latiglumis Shear
*Bromus richardsonii Link.
*Bromus rigidus Roth.
*Hordeum bulbosum L.
Hordeum jubatum L. - Alberta (G. E. Delong (2), Idaho
*Hordeum maritimum With.
Hordeum nodosum L. Idaho
*Phalaris canariensis L.
Wild grasses - California

Puccinia graminis Pers.

Agropyron caninum (L.) Beauv. - Minnesota
Agropyron repens (L.) Beauv. - New York, Minnesota
Agropyron smithii Rydb. - Minnesota
Agropyron tenerum Vasey - Minnesota
Agrostis palustris Huds. - New York (near infected barberry), West Virginia, Minnesota
Alopecurus geniculatus L. - Minnesota
Bromus sp. - Minnesota
Dactylis glomerata L. - New York, Minnesota
Elymus canadensis L. - Minnesota
Elymus virginicus L. - Minnesota
Hordeum jubatum L. - Illinois (near barberry), Minnesota (particularly heavy near barberry), Montana (near barberry), Alberta (2)
Lolium temulentum L. - Minnesota
Grasses (species not given) - Manitoba (V. W. Jackson (2)), and Saskatchewan (P. M. Simmonds (2))

Puccinia poarum Niels.

Poa pratensis L. - South Carolina, Minnesota

Puccinia subnitens Diet.

Distichlis spicata (L.) Greene)salt-grass) - Washington (telial host for rust on spinach)

Pythium sp.

Agrostis palustris Huds. - Whitneyville, Connecticut, October 9. On young grass and new lawn but did not seem to injure roots much. Cultures obtained. (Clinton).

Sclerospora graminicola (Sacc.) Schr.

Chaetochloa italica (L.) Scribn. (Setaria italica Beauv.) - Minnesota
Chaetochloa viridis (L.) Scribn. (Setaria viridis (L.) Beauv.) - Minnesota, Iowa

Scolecotrichum graminis Fckl.

Alopecurus pratensis L. (meadow foxtail) - Indiana

Septoria sp.

Bromus inermis Leyss. (brome grass) - North Dakota
(See also Weber's article in Phytopathology (7)).

Sorosporium syntherismae (Peck) Farl.

Millet - Saskatchewan (2)

Urocystis agropyri (Preuss) Schröt.

Agropyron repens (L.) Beauv. - New York
Agrostis palustris Huds. - Wisconsin (1921, first report on this host (1))
Melica imperfecta Trin. - California (6)

Uromyces dactylidis Otth

Dactylis glomerata L. - Virginia, found at Blacksburg in October; prevalent here, distribution in other parts of state. First collection in Virginia and second in United States. (Fromme)

Ustilago neglecta Niessl

Chaetochloa lutescens (Weigel) Stuntz (Setaria glauca) - Minnesota

Ustilago panici-miliacei (Pers.) Wint.

Panicum miliaceum L. - North Dakota, Washington (5)

Ustilago striaeformis (Westend.) Niessl

Poa pratensis L. - New York

Smut (cause not given)

Bromus spp. - Colorado

MISCELLANEOUS GRASSES

Wojnowicia graminis (McAlp.) Sacc. & D. Sacc.

Agropyron smithii Rydb. - Kansas

Winter injury

Festuca spp. - Connecticut, some of the trouble of lawns consisting of this grass seems to be partly due to winter injury (Clinton)

Recent literature:

(Cited):

(1) Davis, W. H. Urocystis agropyri on redtop. Mycologia 14: 279-281. Sept. 1922

(2) Drayton, F. L., compiler. Survey of the prevalence of plant diseases in the Dominion of Canada, 1922. Third Ann. Rept. (mimeographed). Division of Botany, Experimental Farms Branch, Dept. Agr. 1922

(3) Drechsler, Charles. A new leaf spot of Kentucky Blue Grass caused by an undescribed species of Helminthosporium. (Abstract). Phytopath. 12: 35. Jan. 1922.

(4) _____ The occurrence of zonate eye-spot on various grasses and its mode of extension. (Abstract). Phytopath. 13: 59-60. Jan. 1923.

(5) Heald, F. D. Report of the Division of Plant Pathology. Washington Agr. Exp. Sta. Bul. 167: 38-43. 1922.

(6) U. S. Dept. Agr. Office Path. Coll. Pathological Herbarium Notes 5. Nov. 1, 1922.

(7) Weber, George F. Septoria diseases of cereals. III. Septoria diseases of rye, barley, and certain grasses. Phytopath. 13: 1-23. Jan. 1923.

Septoria agropyri Ell. & Ev. on Agropyron repens; S. bromi Sacc. on Bromus altissimus, B. inermis, (found in 1920, first time reported on this species in this country), B. secalinus; Septoria sp.(not S. graminum Desm.) on Poa pratensis; all in Wisconsin.

(Not cited):

Bubak, Franz. Une nouvelle espece du genre Urocystis. Bol. R. Soc. Espan. Hist. Nat. 22: 205-207. Apr. 1922. Urocystis bolivari on Lolium perenne.

Kulkarni, Gopal Subrao. Smut (Ustilago paradoxa Syd. and Butl.) on sawn (Panicum frumentaceum Roxb.) Jour. Indian Bot. 3: 10-11. May 1922.

Mains, E. B. Observations concerning Puccinia pattersoniana and Puccinia moreniana. Proc. Indiana Acad. 1921: 133-135. 1922.

P. pattersoniana occurs on several grasses (Agropyron spicatum, Elymus condensatus, E. triticoides, Sitanion jubatum) in Montana, Oregon, Washington, Utah, California, and New Mexico. It is believed that the aecial stage may occur on some species of Brodiaea, since the teliospores of P. moreniana, a short cycled rust on Brodiaea capitata, have distinguishing characteristics strikingly similar to those of

P. pattersoniana, and it has previously been found that a number of short cycled rusts possess teliospores very similar to those of heteroecious long cycled species with aecia on the host of the short cycled species; also aecia on B. douglasii have been found associated with P. pattersoniana in Utah.

Maneval, W. E. Germination of teliospores of rusts at Columbia, Missouri. Phytopath. 12: 471-488. Oct. 1922.

Among other rusts studied were the following on grass hosts: Puccinia andropogonis Schw. on Andropogon furcatus Muhl., Puccinia peridermiospora (Ell. & Tracy) Arth. on Spartina michauxiana Hitchc., Puccinia sydowiana Diet. on Sporobolus asper (Michx.) Kunth, Puccinia windsoriae Schw. on Tridens flavus (L.) Hitchc.

Miss Florence Hedges,
Laboratory of Plant Pathology,
U. S. Department of Agriculture,
Washington, D. C.